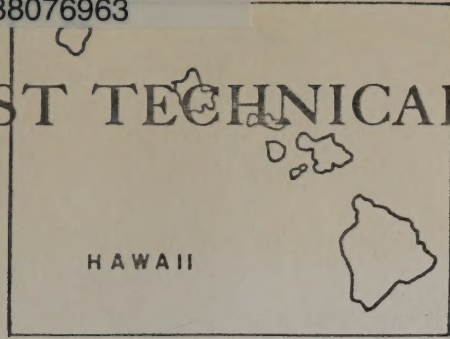




88076963

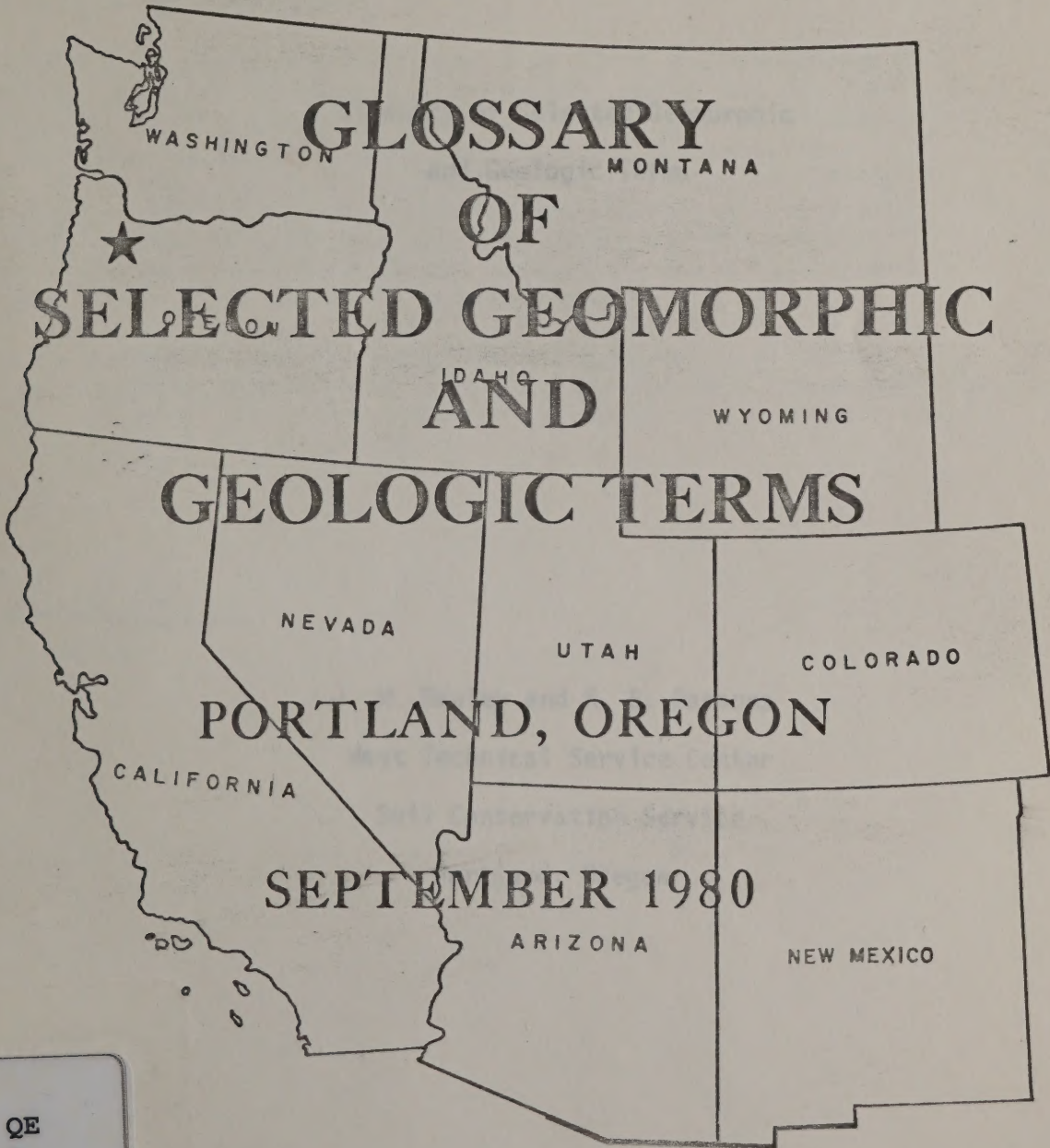
WEST TECHNICAL SERVICE CENTER



ALASKA SERVICE CENTER



SOIL CONSERVATION SERVICE

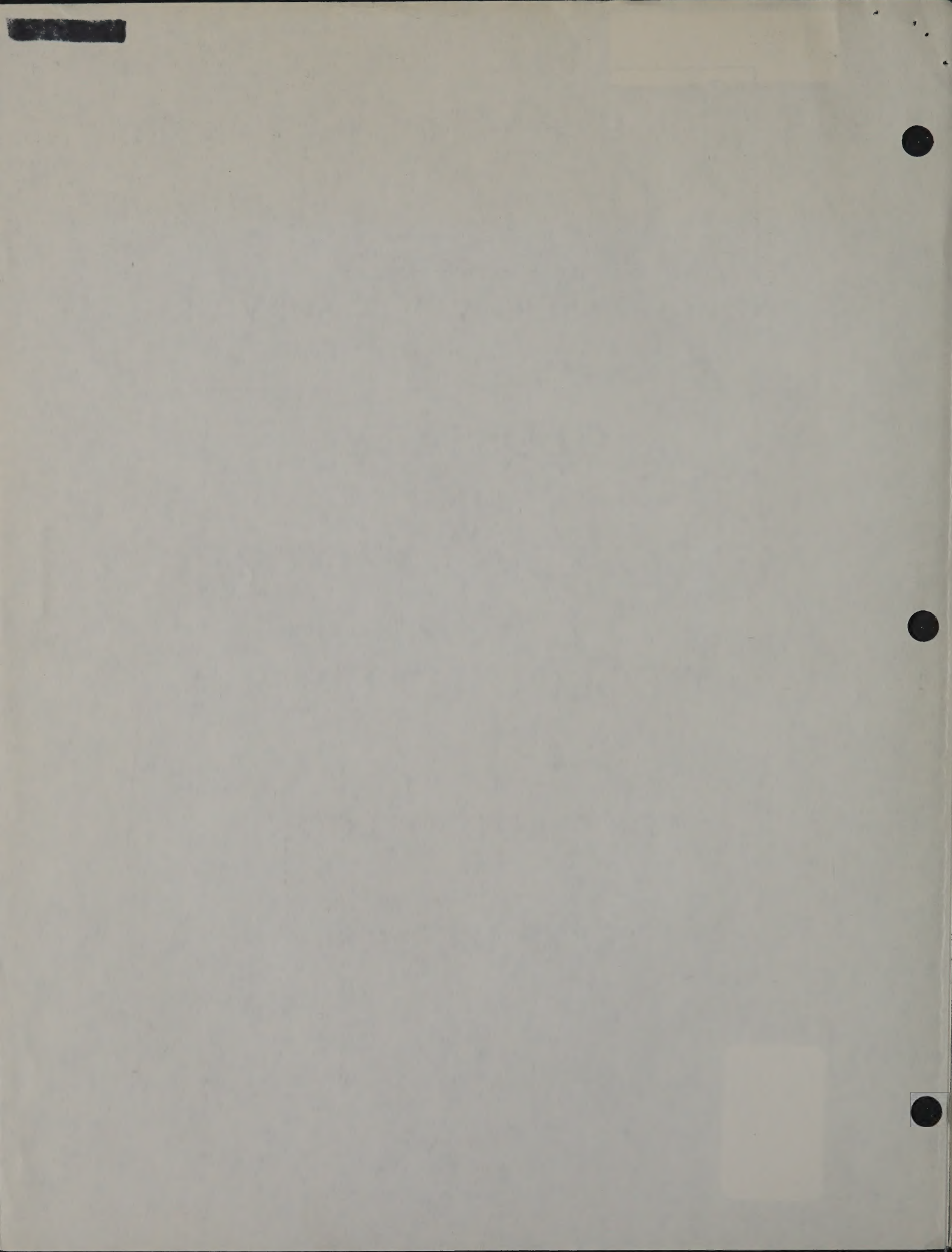


QE

5

.R56

1980





# 37515433

88076963

Rev. 1 9/80

QE  
5  
.R56  
1980

West Technical Service Center  
511 N.W. Broadway, Rm. 310  
Portland, Oregon 97208

Glossary of Selected Geomorphic  
and Geologic Terms

Standardization of earth science terminology for soil series descriptions  
and reports is important in order to insure the occurrence of  
each of such terms has been used accurately or without  
apparent bias or ambiguity.

Soil scientists in the past have used a variety of terms for  
soil erosion, geology, and geomorphology, and the same unit  
has been used for these terms. This glossary, in American  
English, is based on the Glossary of Geology, in  
American English, or in the Glossary of Geology, in  
American English, developed by the American Geological  
Institute. The glossary is a standard reference for the  
soil series. The glossary has been reviewed and  
approved by the Staff before it was published.

Language terminology should be consistent with the official  
series. The glossary, included in the series, will be  
used and listed, as also in any discussion of the series in the  
publications of the series.

*James F. Hawley*  
JAMES F. HAWLEY  
Director

J. W. Hawley and R. B. Parsons  
West Technical Service Center  
Soil Conservation Service  
Portland, Oregon

STUDY OF SELECTED DEMOGRAPHIC  
AND ECONOMIC TRENDS

J. W. HANLEY and R. E. FORTSON  
AND TECHNICAL SERVICE CENTER  
NATIONAL COMMUNITARIAN SERVICE  
PORTLAND, OREGON





United States  
Department of  
Agriculture

Soil  
Conservation  
Service

West Technical Service Center  
511 N.W. Broadway, Rm. 510  
Portland, Oregon 97209

Standardization of earth science terminology for soil series descriptions and manuscripts is important in clearly presenting the occurrence of soils. A number of such terms have been used incorrectly or without reasonable means of verification.

Soil Scientists in the West are encouraged to limit the terminology for soil science, geology, and geomorphology in soil series and map unit descriptions to those terms that appear in the Soil Science Society of America Glossary, in American Geological Institute Glossary, in a Webster's Dictionary, or in the enclosed "Glossary of Selected Geologic and Geomorphic Terms" developed by Drs. Hawley and Parsons. Any term not found in a standard reference should be defined in the manuscript glossary. The nonstandard term and its definition should be reviewed by the Head, Soils Staff before it is widely used.

Landform terminology should be consistent among the official series, series for the manuscript, mapping units, and general soil map descriptions and legend, and also in any discussion of the series in the genesis section or any other part of the manuscript.

CHARLES F. LEMON  
Director



West Technical Service Center  
211 N. Broadway, 2nd Fl.  
Portland, Oregon 97208


Soil  
Conservation  
Service

Soil  
Conservation  
Service

Standardization of earth science terminology for soil series descriptions and manuscripts is important to clearly presenting the occurrence of soil. A number of such terms have been used incorrectly or without reasonable sense of verification.

Soil scientists in the West are encouraged to limit the terminology for soil science, geology, and geomorphology in soil series and map unit descriptions to those terms that appear in the Soil Science Society of America Glossary, the American Geological Institute Glossary, in a Glossary of Geology, or in the annotated Glossary of Selected Geologic and Geographic Terms developed by Dr. Henry and Parsons. Any term not found in a standard reference should be defined in the manuscript glossary. The standard term and its definition should be verified by the field staff before it is widely used.

Language terminology should be consistent among the official series series for the component, mapping units, and general soil map descriptions. See also the discussion of the series in the general section of the manual part of the manuscript.

  
WALTER T. LIND  
Director



## INTRODUCTION TO GLOSSARY OF SELECTED GEOLOGIC AND GEOMORPHIC TERMS

Attached is the glossary of selected geologic and geomorphic terms prepared for the Cooperative Soil Survey in the Western States. About 195 terms are defined.

In selecting terms for definition I reviewed pertinent items in recent soil survey manuscripts, the 1976 edition of the SCSA Resource Conservation Glossary, the SSSA Glossary of Soil Science Terms, and the American Geological Institute Glossary (see 1980 edition by Bates and Jackson). To this basic list were added terms that are commonly used in current geologic, physical geographic, and soil-geomorphic literature. Some of this terminology has been developed or refined during the course of the four major SCS Soil-Geomorphology Projects in Iowa, New Mexico, North Carolina, and Oregon.

Dr. Rog Parsons made many suggestions for additions, wording changes, deletions and provided a number of definitions for the first revision. We tested definitions at field training sessions for ongoing soil surveys throughout the West.

We regard this glossary as a state-of-the-art effort that certainly will be improved with further work. It is designed primarily for use during the course of a soil survey, especially as an aid in literature review and geologic map interpretation early in the survey. (See sections 302.3 and 302.6, Part II, National Soils Handbook).

There are three major categories of terms: (1) earth materials, (2) landforms, and (3) geomorphic processes. Definitions of geologic-geomorphic terms are commonly long and complex because abstract genetic as well as concrete physical and chemical attributes are usually involved. For example, asymmetric ridges produced by differential erosion of gently dipping, resistant and weak strata are termed "cuestas." Identical topographic features comprising tilted fault blocks are not cuestas. As in the case of Soil Taxonomy, many definitions contain words with special meanings given elsewhere in the glossary. Thus, a considerable amount of cross referencing is required.

Finally, certain types of terminology are much too complex for clear presentation in a glossary. Works listed in the attached bibliography should be consulted for basic earth science information. General landform and geomorphic process information is well presented by Bloom (1978), Fairbridge (1968), Hunt (1974), Ritter (1978), Schumm (1977), and Thornbury (1965, 1969).

Special geomorphic processes and products are covered by Cooke and Warren (1973), Flint (1971) and Wyllie (1976). The best textbooks on soil-geomorphic relationships are by Birkeland (1974) and Ruhe (1975). Soil Survey Investigations Project Reports by Daniels, Gamble, Gile, Parsons, Ruhe, and associates are the best source of information on this subject. Techniques of field geology, including clear explanations of field classifications of igneous and metamorphic rocks, are presented by Compton (1962). Pettijohn (1975) should be consulted for up-to-date information on sedimentary and pyroclastic rocks. Recently published introductory geology texts by Compton (1977), Hamblin (1975), and Hamblin and Howard (1980) are highly recommended. Finally the 1975 American Geological Institute Data Sheet edition provides very useful summaries of geologic information (eg. rock classification and composition) that can be inserted in field notebooks. All books listed should be obtained for SCS State Office libraries, and within-state circulation. Asterisks denote books that are useful in field office libraries.

JOHN W. HAWLEY  
Socorro, New Mexico  
June 1980

INFORMATION TO ASSIST IN CHOICE OF SUBJECTS AND RESEARCH TOPICS

It is the purpose of this report to provide information and suggestions for the selection of subjects for research in the field of psychology. The information is based on a survey of the literature in this field and on the experience of the author in the selection of subjects for research.

In selecting subjects for research, the researcher should consider the following factors: (1) the nature of the research problem, (2) the availability of subjects, (3) the characteristics of the subjects, and (4) the ethical considerations. The researcher should also consider the following factors: (1) the nature of the research problem, (2) the availability of subjects, (3) the characteristics of the subjects, and (4) the ethical considerations.

The researcher should also consider the following factors: (1) the nature of the research problem, (2) the availability of subjects, (3) the characteristics of the subjects, and (4) the ethical considerations.

The researcher should also consider the following factors: (1) the nature of the research problem, (2) the availability of subjects, (3) the characteristics of the subjects, and (4) the ethical considerations.

The researcher should also consider the following factors: (1) the nature of the research problem, (2) the availability of subjects, (3) the characteristics of the subjects, and (4) the ethical considerations.

The researcher should also consider the following factors: (1) the nature of the research problem, (2) the availability of subjects, (3) the characteristics of the subjects, and (4) the ethical considerations.

The researcher should also consider the following factors: (1) the nature of the research problem, (2) the availability of subjects, (3) the characteristics of the subjects, and (4) the ethical considerations.

W. J. H. ...  
...  
...



ablation till

Loose permeable till deposited during the final downwasting of nearly static glacial ice. Lenses of crudely sorted sand and gravel are common. (cf. glacial till, moraine)

active slope

A mountain or hill slope that is responding to valley incision, with erosion (either geologic or accelerated) exceeding regolith weathering, and that has detritus accumulated behind obstructions indicating contemporary transport of slope alluvium. Slope gradients usually exceed 45 percent. (cf. metastable slope)

alluvial

Pertaining to material or processes associated with transportation or deposition by running water.

alluvial cone

The material washed down mountain and hill slopes by ephemeral streams and deposited at the mouth of gorges in the form of a moderately steep conical mass descending equally in all directions from the point of issue.

alluvial fan

A body of alluvium, with or without debris flow deposits, whose surface forms a segment of a cone that radiates downslope from the point where the stream emerges from a narrow valley onto a plain. Common longitudinal profiles are gently sloping and nearly linear. Source uplands range in relief and areal extent from mountains and plateaus to gullied terrains on hill and piedmont slopes.

alluvial terrace

(cf. stream terrace)

alluvium

Unconsolidated clastic material deposited by running water, including gravel, sand, silt, clay and various mixtures of these.

anticline

A unit of folded strata that is convex upward. In a single anticline beds forming the opposing limbs of the fold dip away from its axial plane. (cf. syncline, monocline)

These particles are deposited during the final downwasting of nearly static glacial ice. Lenses of crudely sorted sand and gravel are common. (cf. glacial till, moraine)

active slope

A mountain or hill slope that is responding to valley incision, with erosion (either geologic or accelerated) exceeding regolith weathering, and that has a high potential for mass wasting. Slope gradients usually exceed 45 percent. (cf. metastable slope)

alluvial

Pertaining to material or processes associated with transportation or deposition by running water.

alluvial cone

The alluvial wedge down mountain and hill slopes by ephemeral streams and deposited at the mouth of gorges in the form of a moderately steep conical mass descending usually in all directions from the point of issue.

alluvial fan

A body of alluvium, with or without debris flow deposits, whose surface forms a part of a cone that radiates downward from the point where the stream emerges from a narrow valley onto a plain. Common longitudinal profiles are gently sloping and nearly linear. Source uplands range in relief and are usually composed of granitic and gneissic to gabbroic terrain on hills and glacial slopes.

alluvial terrace

(cf. stream terrace)

alluvium

Unconsolidated clastic material deposited by running water, including gravel, sand, silt, clay, and various mixtures of these.

anticline

A fold of folded strata that is convex upward. In a single anticline part forming the opposing limbs of the fold dip away from its axial plane. (cf. syncline, monocline)



## arête

A narrow, jagged mountain crest, often above the snowline, sculptured by alpine glaciers and formed by backward erosion of adjoining cirque walls.

## arroyo

The flat-floored channel of an ephemeral stream, commonly with very steep to vertical banks cut in alluvium (regional term - Southwest; syn. wash).  
NOTE: Where arroyo reaches intersect zones of ground-water discharge they are more properly classed as intermittent stream channels.

## ash (volcanic)

Fine pyroclastic material under 4.0 mm diameter.

## backslope (hillslope)

The geomorphic component that forms the steepest inclined surface and principal element of many hillslopes (e.g., valley side, ridge side). Backslopes in profile are commonly steep, linear, and may or may not include cliff segments, also called "gravity slopes" or "free faces." The term "mid-slope" may be used to designate an element without a cliff. In terms of gradational process, backslopes are erosional forms produced mainly by mass wasting and running water. NOTE: Structural geomorphologists may use the term as a synonym of dipslope in describing homoclinal ridges (e.g., cuesta "backslope"). (cf. footslope, shoulder)

## backswamp (flood-plain landform)

Extensive, marshy, depressed areas of flood plains between the natural levee borders of channel belts and valley sides or terraces. (cf. valley flat)

## bajada (bahada)

A broad, gently-inclined, piedmont slope formed by lateral coalescence of a series of alluvial fans, and having a broadly undulating transverse profile (parallel to the mountain front) due to the convexities of component fans. The term is generally restricted to constructional slopes of intermontane basins in the southwest U.S.A. (syn. coalescent fan piedmont)

## bar and channel

The microrelief common to flood plains and relatively young alluvial terraces. With time the microrelief becomes subdued as the higher lying bars erode into the channels. The ridge-like bars often consist of accumulations of coarse sediment, while the channels are finer textured. The relief between bar and channel is largely related to the competence of the stream.

A narrow, jagged mountain crest, often above the snowline, sculptured by alpine glaciers and formed by backward erosion of adjoining cirque walls.

arroyo

The flat-floored channel of an ephemeral stream, commonly with very steep to vertical banks cut in alluvium (regional term - southwest, esp. wash).  
NOTE: Some arroyos reach interesting zones of ground-water discharge they are more properly classed as intermittent stream channels.

ash (volcanic)

From pyroclastic material under 4.75 mm diameter.

backlope (hillside)

The geomorphic component that forms the steepest inclined surface and back-tilt element of many hillslopes (e.g., valley side, ridge side). Back-tilt hillslopes are commonly steep, linear, and may or may not include cliff segments, also called "gravity slopes" or "free faces". The term "mid-slope" may be used to designate an element without a cliff. In terms of gradational processes, backlopes are erosional forms produced mainly by mass wasting and rilling. NOTE: Structural geomorphologists may use the term as a synonym for "back-slope" in describing tectonic ridges (e.g., coastal "backslope").

barren (flood-plain landform)

Relative, rarely, depressed areas of flood plains between the natural levee borders of channel belts and valley sides or terraces. (cf. valley flat)

basin (synclinal)

A broad, gently-inclined, pibedent slope formed by lateral coalescence of a series of alluvial fans, and having a broadly undulating transverse profile (parallel to the mountain front) due to the convexities of component fans. The term is generally restricted to constructional slopes of intermontane basins in the southern U.S.A. (syn. coalescent fan piedmont).

bar and channel

The microrelief common to flood plains and relatively young alluvial fans. With time the microrelief becomes subdued as the higher lying bars erode into the channels. The ridge-like bars often consist of accumulations of coarse sediment, while the channels are finer textured. The relief between bar and channel is largely related to the competence of the stream.



## basal till

Compact till, commonly clay rich, deposited beneath a moving glacier. Lodgement till is a variety characterized by dense fissile structure and stones oriented with long axes roughly parallel to direction of ice movement. (cf. glacial till)

## base level

The theoretical limit or lowest level toward which erosion of the earth's surface constantly progresses but seldom, if ever, reaches; especially the level below which a stream cannot erode its bed. The ultimate base level for the land surface is sea level, but temporary base levels may exist locally. The base level of eolian erosion may be above or below sea level; that of marine erosion is the lowest level to which marine agents can cut a bottom.

## basin (intermontane)

A broad structural lowland, commonly elongated and many miles across, between mountain ranges. Major component landforms are basin floors and piedmont slopes. Floors of internally-drained basins (bolsons) contain one or more closed depressions, with temporary lakes (playas), and alluvial plains. In basins with through drainage, alluvial plains are dominant and lakes are absent or of small extent. Piedmont slopes comprise erosional surfaces (pediments) of individual and/or coalescent alluvial fans. (cf. valley)

## basin floor

A general term for the nearly level to gently sloping, bottom surface of an intermontane basin (bolson). Component landforms include playas, broad alluvial flats containing ephemeral drainageways, and relict alluvial and lacustrine surfaces that rarely if ever are subject to flooding. Where through-drainage systems are well developed alluvial plains are dominant and lake plains are absent or of limited extent. Basin floors grade mountainward to distal parts of piedmont slopes.

## bedrock

The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface. (cf. regolith)

## bench

(cf. structural bench)

## bolson

An internally drained (closed), intermontane basin with two major land-form components: basin floor and piedmont slope. The former includes nearly level alluvial plains and playa-lake depressions. The latter comprises slopes

level (iii)

Compact till, commonly clay rich, deposited beneath a moving glacier. (compact till) is a variety characterized by dense fissile structure and stones oriented with long axes roughly parallel to direction of ice movement. (cf. glacial till)

base level

The theoretical level of lowest level toward which erosion of the earth's surface constantly progresses but seldom, if ever, reaches; especially the level below which a stream cannot erode its bed. The ultimate base level for the land surface is sea level, but temporary base levels may exist locally. The base level of erosion may be above or below sea level; that of marine erosion is the lowest level to which marine agents can cut a bottom.

basin (intermontane)

A broad structural lowland, commonly elongated and many miles across, between mountain ranges. Major component landforms are basin floors and graben. Floors of interally-derived basins (paterns) contain one or more closed depressions with temporary lakes (playas), and alluvial plains. In basins with drainage, alluvial plains are dominant and lakes are absent or of small extent. Piedmont slopes comprise extensive surfaces (extensities) of internal and/or confluent alluvial fans. (cf. valley)

basin floor

A general term for the nearly level to gently sloping bottom surface of an intermontane basin (patern). Component landforms include playas, broad alluvial fans containing conical depressions, and salt flats and salt lakes. The surface may vary in elevation and is subject to flooding. Where drainage is present, well developed alluvial plains are dominant and lake plains are absent or of limited extent. Basin floor grade mountainside to higher parts of piedmont slopes.

bedrock

The solid rock that underlies the soil and other unconsolidated materials as they are exposed at the surface. (cf. topolith)

bench

(cf. structural bench)

bluffs

An internally-derived (narrowly, intermontane) basin with two major landforms: a central basin floor and a rimmed edge. The former includes nearly level alluvial plains and clay lake depressions. The latter comprises slopes



of erosional origin adjoining the mountain fronts (pediments) and complex constructional surfaces (bajadas) mainly composed of individual and/or coalescent alluvial fans. (regional term Southwest)

braided channel or stream (flood plain landforms)

A channel or stream with multiple channels that interweave as a result of repeated bifurcation and convergence of flow around interchannel bars, resembling in plan the strands of a complex braid. Braiding is generally confined to broad, shallow streams of low sinuosity, high bedload non-cohesive bank material, and steep gradient. At a given bank-full discharge braided streams have steeper slopes, and shallower, broader and less stable channel cross sections than meandering streams. (cf. flood plain landforms)

breaks

The steep to very steep broken land at the border of an upland summit that is dissected by ravines.

breccia

A coarse-grained clastic rock composed of angular rock fragments (larger than 2 mm), commonly cemented together in a finer-grained matrix of varying composition and origin. The consolidated equivalent of rubble. (cf. conglomerate)

buried

Pertaining to landforms, geomorphic surfaces and paleosols covered by a mantle of geologic material (e.g., sedimentary or volcanic).

butte

An isolated, usually flat-topped upland mass characterized by summit widths that are less than heights of bounding erosional scarps. An upland type produced by differential erosion of nearly horizontal, interbedded weak and resistant rocks, with the latter comprising caprock layers. As summit area increases relative to height, buttes are transitional to mesas. (cf. plateau, cuesta)

caliche

A general term for a prominent zone of secondary carbonate accumulation in surficial materials of warm, subhumid to arid areas formed by both geologic and pedologic processes. Finely crystalline calcium carbonate forms a nearly continuous surface-coating and void-filling medium in geologic (parent) materials. Cementation ranges from weak in nonindurated forms to very strong in types that are indurated. Other minerals (carbonate, silicate, sulphate) may be present as accessory cements.

of erosion origin adjoining the mountain fronts (bedforms) and complex  
conformable surfaces (beds) mainly composed of individual and/or  
conformable alluvial fans. (regional term southwest)

bedded channel or stream (flood plain landform)

A channel or stream with multiple channels that interweave as a result of  
repeated bifurcation and convergence of flow around interchannel bars, resulting  
in plan the stream of a complex braid. Bifurcation is generally confined to  
broad, shallow streams of low sinuosity, high bedload non-cohesive bank material,  
and steep gradient. At a given bank-full discharge braided streams have  
steeper slopes, and narrower, broader and less stable channel cross sections  
than meandering streams. (cf. flood plain landform)

beds

The steep to very steep broken land at the border of an upland summit  
that is dissected by ravines.

beds

A coarse-grained classic rock composed of angular rock fragments (larger  
than 2 mm), commonly cemented together in a finer-grained matrix of varying  
composition and origin. The consolidated equivalent of rubble. (cf. conglom-  
erate)

beds

bedded to landform, geomorphic surface and paleosol covered by a  
matrix of geologic material (e.g., sandstone or siltstone).

beds

An isolated, usually flat-topped upland mass characterized by summit  
width that are less than heights of bounding erosional scarps. An upland  
type produced by differential erosion of nearly horizontal, interbedded weak  
and resistant rocks, with the latter comprising caprock layers. As summit  
area increases relative to height, buttes are transitional to mesas. (cf.  
pinnacle, mesa)

beds

A general term for a prominent zone of secondary carbonate accumulation  
in surficial materials of warm, subtropical to arid areas formed by both geologic  
and biogenic processes. Finely crystalline calcine carbonate forms a nearly  
continuous noncrystalline and void-filling medium in geologic (parent) materials.  
Calcification ranges from weak to nonindurated forms to very strong in types  
that are indurated. Other minerals (carbonate, silicate, sulphate) may be  
present as secondary cement.



canyon

A long, deep, narrow, very steep-sided valley with high and precipitous walls in an area of high local relief (e.g., mountain or high plateau terrain).

catsteps

(cf. terracettes)

cirque

Semicircular, concave, bowl-like areas with steep faces primarily resulting from glacial ice and snow abrasion.

clast

An individual constituent, grain, or fragment of sediment or rock, produced by the mechanical weathering (disintegration) of a larger rock mass.

clastic

Pertaining to a rock or sediment composed mainly of fragments derived from preexisting rocks or minerals and moved from their place of origin. (cf. detritus, epiclastic, pyroclastic)

coalesced fan piedmont

(cf. bajada)

colluvial

Pertaining to material transported and deposited by mass wasting (direct gravitational action) and local unconcentrated runoff on and at the base of steep slopes.

colluvium

Unconsolidated earth material deposited on and at the base of steep slopes by mass wasting (direct gravitational action) and local unconcentrated runoff.

congeliturbate

Unconsolidated earth material moved or disturbed by frost action.

A long, deep, narrow, very steep-sided valley with high and precipitous walls in an area of high relief (e.g., mountain or high plateau terrain).

colony

(cf. larvaceae)

cliff

Steep, vertical, concave, bowl-like areas with steep faces primarily resulting from glacial ice and snow abrasion.

clast

An individual constituent, grain, or fragment of sediment or rock, produced by the mechanical weathering (disintegration) of a larger rock mass.

clastic

Pertaining to a rock or sediment composed mainly of fragments derived from preexisting rocks or minerals and moved from their place of origin. (cf. detrital, eolian, glacial, pyroclastic)

condensed fan deposit

(cf. talus)

colony

Pertaining to material transported and deposited by mass wasting (direct gravitational action) and local unconcentrated runoff on and at the base of steep slopes.

colony

Unconsolidated earth material deposited on and at the base of steep slopes by mass wasting (direct gravitational action) and local unconcentrated runoff.

colony

Unconsolidated earth material moved or displaced by frost action.



## conglomerate

A coarse-grained, clastic rock composed of rounded to subangular rock fragments, (larger than  $2\text{ mm}$ ) commonly with a matrix of sand and finer material; cements include silica, calcium carbonate, and iron oxides. The consolidated equivalent of gravel. (cf. breccia)

## constructional (geomorph.)

Owing its origin, form, position or general character to depositional (aggradational) processes, such as accumulation of sediment to form an alluvial fan or terrace. (cf. erosional)

## creep

Slow mass movement of earth material down relatively steep slopes, primarily under influence of gravity but facilitated by saturation with water and frost action.

## cuesta

An asymmetric, homoclinal ridge capped by resistant rock layers of slight to moderate dip ( $<10^\circ$ ,  $<16\%$ ); produced by differential erosion of interbedded resistant and weak rocks. A long, gently sloping to sloping face (dipslope) roughly paralleling the inclined beds, opposes a relatively short and steep (scarp) face cut across the tilted rocks. (cf. hogback, mesa)

## debris

Any surficial accumulation of loose material detached from rock masses by chemical and mechanical means, as by decay and disintegration, and occurring in the place where it was formed, or transported by water or ice and redeposited. It consists of rock fragments, finer-grained earth material, and sometimes organic matter.

## debris flow (mudflow)

A mass movement process involving rapid flowage of highly viscous mixtures of debris, water, and entrapped air. Water content may range up to 60%. A mudflow is a type of debris flow with clastic particles of sand size and finer. (cf. alluvial fan)

## delta

A body of alluvium, whose surface form is nearly flat and fan-shaped, deposited at or near the mouth of a river or stream where it enters a body of relatively quiet water, usually a sea or lake.

conglomerates

A coarse-grained, clastic rock composed of rounded to subangular rock fragments (larger than 2 mm) commonly with a matrix of sand and finer material; concrete include silica, calcium carbonate, and iron oxides. The consolidated equivalent of gravel. (cf. breccia)

construction (geomorph.)

Being the origin, form, position or general character of depositional (sedimentary) processes, such as accumulation of sediment to form an alluvial fan or delta. (cf. evolution)

creep

Slow rate movement of earth material down relatively steep slopes, primarily under influence of gravity but facilitated by saturation with water and frost action.

delta

An asymmetric, fan-shaped ridge caused by resistant rock layers of slight to moderate dip (<10°-50°), produced by differential erosion of interbedded resistant and weak rocks. A long, gently sloping to steep face (dip slope) usually parallel to the bedrock, opposite a relatively short and steep (steep) face cut across the tilted rocks. (cf. hogback, mesa)

deltaic

The surficial accumulation of loose material detached from rock masses by physical and mechanical means, as by decay and disintegration, and occurring in the place where it was formed, or transported by water or ice and redeposited. It consists of rock fragments, fine-grained earth material, and sometimes organic matter.

deltaic flow (deltaic)

A slow movement process involving rapid flowage of highly viscous mixtures of deltaic silt, and entrained air. Water content may range up to 50%. A result of a flow of deltaic flow with clastic particles of sand size and finer. (cf. alluvial fan)

deltaic

A body of siltstone, whose surface form is usually flat and low-sloped, deposited at or near the mouth of a river or stream where it enters a body of relatively quiet water, usually a sea or lake.



## desert pavement

A layer of gravel or coarser fragments on desert soil surfaces that (1) was emplaced by upward movement of fragments from underlying sediments, or (2) formed as a lag concentrate after finer particles have been removed by running water or wind (i.e., a variety of erosion pavement).

## detritus

Rock and mineral fragments occurring in sediments that were derived from pre-existing igneous, sedimentary, or metamorphic rocks.

## dipslope

A slope of the land surface, roughly determined by and approximately conforming with the dip of underlying bedded rocks; for example, the long, gently inclined surface of a cuesta. (syn. structural backslope; cf. scarp slope)

## draw

A small stream valley, generally more open and with broader bottom land than a ravine or gulch.

## drumlin

A low, smooth, elongated oval hill, mound, or ridge of compact glacial till that may or may not have a core of bedrock or stratified glacial drift. The longer axis is parallel to the general direction of glacier flow. Drumlins are products of streamline flow of glaciers which molded the subglacial floor through a combination of erosion and deposition.

## dune

A mound, ridge, or hill of loose, windblown granular material (generally sand), either bare or covered with vegetation.

## dune (barchan)

A crescent-shaped dune with tips extending to the leeward, making this side concave in plan and the windward side convex. Barchan (parabolic) dunes tend to be arranged in chains extending in the direction of the most effective wind.

## dune (parna)

A dune largely composed of sand-size aggregates of clay.

desert pavement

A layer of gravel or coarse fragments on desert soil surfaces that (1) was replaced by upward movement of fragments from underlying sediments, or (2) formed as a lag concentrate after finer particles have been removed by running water or wind (i.e., a variety of erosion pavement).

detritus

Rock and mineral fragments occurring in sediments that were derived from preexisting igneous, sedimentary, or metamorphic rocks.

dip slope

A slope of the land surface, roughly determined by and approximately contoured with the dip of underlying bedded rocks; for example, the long, gently inclined surface of a cuesta. (Syn. structural backslope; cf. scarp slope)

draw

A small stream valley, generally more open and with broader bottom land than a ravine or gulch.

drift

A low, smooth, elongated oval hill, mound, or ridge of compact glacial till that may or may not have a core of bedrock or stratified glacial drift. The longer axis is parallel to the general direction of glacier flow. Distinctive are products of glacial flow of glaciers which molded the subglacial floor through a combination of erosion and deposition.

dune

A mound, ridge, or hill of loose, windblown granular material (generally sand), either bare or covered with vegetation.

dune (barren)

A crescent-shaped dune with tips extending to the leeward, making this side concave to the wind and the windward side convex. Barren (barbolic) dunes tend to be arranged in chains extending in the direction of the most effective wind.

dune (barren)

A dune largely composed of sand-size aggregates of clay.



dune (seif)

A longitudinal dune about six times as wide as it is high and oriented parallel, rather than transverse, to the prevailing wind.

eolian

Pertaining to material transported and deposited by the wind. Includes earth materials ranging from dune sands to silty loess deposits.

ephemeral stream

A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is at all times above the water table. (cf. arroyo, intermittent stream)

epiclastic

Pertaining to any clastic rock or sediment other than pyroclastic. Constituent fragments are derived by weathering and erosion rather than by direct volcanic processes. (cf. volcanoclastic)

erosion

The wearing away of the land surface by running water, waves, moving ice and wind, or by such processes as mass wasting and corrosion (solution and other chemical processes). The term "geologic erosion" refers to natural processes occurring over long (geologic) time spans.

erosional (geomorph.)

Owing its origin, form, position or general character to wearing-down (degradational) processes, such as removal of weathered rock debris by any mechanical or chemical processes to form, for example, a pediment or valley-side slope. (cf. constructional)

erosion pavement

A concentration of gravel or coarser fragments that remains on the soil surface as a lag after finer particles have been removed by running water or wind. (cf. stone line, desert pavement)

escarpment

A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and produced by erosion or faulting. The term is more often applied to cliffs produced by differential erosion and it is commonly used synonymously with "scarp."

dune (sand)

A longitudinal dune about six times as wide as it is high and oriented parallel, rather than transverse, to the prevailing wind.

colluvium

Pertaining to material transported and deposited by the wind. Includes earth materials ranging from dune sands to silty loess deposits.

epifluvial stream

A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is at all times above the water table. (cf. arroyo, intermittent stream)

epihercynitic

Pertaining to any class of rock or sediment other than pyroclastic. Con- sidered fragments are derived by weathering and erosion rather than by direct volcanic processes. (cf. volcanoclastic)

erosion

The wearing away of the land surface by running water, waves, moving ice and wind, or by such processes as mass wasting and corrosion (solution and other chemical processes). The term "geologic erosion" refers to natural processes occurring over long (geologic) time spans.

erosional (geographic)

During its origin, form, position or general character to wearing-down (erosional) processes, such as removal of weathered rock debris by any mechanical or chemical process to form, for example, a pediment or valley-side slope. (cf. constructional)

erosion pavement

A consolidation of gravel or coarser fragments that remain on the soil surface as a lid after finer particles have been removed by running water or wind. (cf. desert pavement)

escarpment

A relatively continuous and steep slope or cliff breaking the general continuity of some gently sloping land surface and produced by erosion or faulting. The term is more often applied to cliffs produced by differential erosion and is commonly used synonymously with "scarp."



esker

A long, narrow, sinuous, steep-sided ridge composed of irregularly stratified sand and gravel that was deposited by a subsurface stream flowing between ice walls or in an ice tunnel of a retreating glacier, and was left behind when the ice melted. Eskers range in length from less than a kilometer to more than 160 km, and in height from 3 to 30 m. (cf. glaciofluvial deposits)

exhumed

Pertaining to formerly buried landforms, geomorphic surfaces or paleosols that have been re-exposed at the ground surface by erosion of the covering mantle. (cf. relict)

extrusive

Denoting igneous rocks derived from deep-seated molten matter (magmas) emplaced on the earth's surface. (cf. intrusive; volcanic)

facies (stratigraphy)

The sum of all primary lithologic and paleontologic characteristics exhibited by a sedimentary rock and from which its origin and environment of formation may be inferred; the general nature or appearance of a sedimentary rock produced under a given set of conditions; a distinctive group of characteristics that distinguishes one group from another within a stratigraphic unit. (e.g., contrasting river-channel facies and overbank-flood-plain facies in alluvial valley fills)

fan terrace

A relict alluvial fan, no longer a site of active deposition, incised by younger and lower alluvial surfaces. An abandoned former fan surface.

fault

A fracture or fracture zone of the earth with displacement along one side in respect to the other.

flood plain

The nearly level alluvial plain that borders a stream and is subject to inundation under flood-stage conditions unless protected artificially. It is usually a constructional landform built of sediment deposited during overflow and lateral migration of the stream.

A long, narrow, straight, stepped ridge composed of irregularly sized  
fines sand and gravel that was deposited by a subglacial stream flowing  
between ice walls or in an ice tunnel of a retreating glacier, and was left  
behind when the ice melted. Elevation range is length from less than a kilometer  
to more than 100 km, and in height from 3 to 30 m. (cf. glacially  
deposited)

landform

Pertaining to formerly buried landforms, geomorphic surfaces or paleosols  
that have been re-exposed at the ground surface by erosion of the covering  
material. (cf. relict)

extensive

Denoting igneous rocks derived from deep-seated molten matter (magma)  
emplaced on the earth's surface. (cf. intrusive; volcanic)

facies (stratigraphy)

The use of all primary lithologic and paleontologic characteristics ex-  
hibited by a sedimentary rock and from which its origin and environment of  
formation can be inferred; the general nature or appearance of a sedimentary  
rock produced under a given set of conditions; a distinctive group of char-  
acteristics that distinguishes one group from another within a stratigraphic  
unit. (e.g., contrasting river-channel facies and overbank-flood-plain facies  
in alluvial valley fills)

fan surface

A radial alluvial fan, no longer a site of active deposition, incised by  
gullies and other alluvial surfaces. An abandoned former fan surface.

fault

A fracture or fracture zone of the earth with displacement along one side  
in respect to the other.

floor plain

The nearly level alluvial plain that borders a stream and is subject to  
inundation under flood-stage conditions unless protected artificially. It is  
usually a constructional landform built of sediment deposited during overflow  
and lateral migration of the stream.



## flood-plain landforms

A variety of constructional and erosional features produced by stream channel migration and flooding. (e.g., backswamps, braided channels and streams, flood plain splays, meander, meander belt, meander scrolls, oxbow lakes, natural levees, and valley flats.)

## flood-plain splay

(cf. meander belt)

## fluvial

Of or pertaining to rivers; produced by river action, as a fluvial plain.

## foothills

A steeply sloping upland with hill relief (up to 1000 ft, 300 m) that fringes a mountain range or high-plateau escarpment. (cf. hill, mountain, plateau)

## footslope

The geomorphic component that forms the inner gently inclined surface at the base of a hillslope. The surface profile is dominantly concave; and in terms of gradational processes, it is a transition zone between upslope sites of erosion (backslope) and downslope sites of deposition (toeslope). (cf. hillslope)

## formation (stratigraphy)

The basic rock-stratigraphic unit in the local classification of rocks. A body of rock (commonly a sedimentary stratum or strata, but also igneous and metamorphic rocks) generally characterized by some degree of internal lithologic homogeneity or distinctive lithologic features (such as chemical composition, structures, textures, or general kind of fossils), by a prevailing (but not necessarily tabular) shape, and by mappability at the earth's surface (at scales of the order of 1:25,000) or traceability in the subsurface.

## geomorphology

The science that treats the general configuration of the earth's surface; specifically the study of the classification, description, nature, origin, and development of landforms and their relationships to underlying structures, and of the history of geologic changes as recorded by these surface features.

Flood-plain features

A variety of constructional and erosional features produced by stream channel migration and flooding. (e.g., backswamp, oxbow channels and stream, flood plain aggradation, meander belt, meander scrolls, oxbow lakes, natural levees, and valley flats.)

Flood-plain aggradation

(cf. meander belt)

Footwall

Up or pertaining to rivers; produced by river action, as a flood plain.

Footwall

A steeply sloping upland with [fill] relief (up to 1000 ft, 300 m) that fringes a mountain range or high-plateau escarpment. (cf. hill, mountain, plateau)

Footwall

The geographic component that forms the inner gently inclined surface at the base of a hillside. The surface profile is dominantly concave; and in some of gradational processes, it is a transition zone between upland sites of erosion (backstep) and downslope sites of deposition (footslope). (cf. hillside)

Footwall (stratigraphy)

The basic rock-stratigraphic unit in the local classification of rocks. A body of rock (commonly a sedimentary stratum or strata, but also igneous and metamorphic rocks) generally characterized by some degree of internal lithologic homogeneity or distinctive lithologic features (such as chemical composition, structure, texture, or general kind of fossils), by a prevailing (but not necessarily uniform) shape, and by susceptibility at the earth's surface (at scales of the order of 1:25,000) or traceability in the subsurface.

Geomorphology

The science that treats the general configuration of the earth's surface; specifically the study of the classification, description, nature, origin, and development of landforms and their relationships to underlying structures, and to the history of geologic changes as recorded by these surface features.



## geomorphic surface

A geomorphic surface represents an episode of landscape development and consists of one or more landforms (Balster and Parsons). A mappable part of the land surface that is defined in terms of morphology (relief, slope, aspect, etc.), origin (erosional, constructional, etc.), age (absolute, relative), and stability of component landforms. (cf. buried, exhumed, relict)

## glacial drift

All rock material transported and deposited by glacial ice and meltwater; includes glacial till, glaciofluvial (outwash), and glaciolacustrine deposits from alpine, piedmont, or continental glaciers.

## glacial outwash

Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by water that originated mainly from the melting of glacial ice. Outwash deposits may occur in the form of valley fills (valley trains and/or outwash terraces) or as widespread outwash plains. (cf. glacial drift, glaciofluvial deposits)

## glaciofluvial deposits

Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and may occur in the form of outwash plains, valley trains, and deltas, kames, eskers, and kame terraces. (cf. glacial drift and glacial outwash)

## glaciolacustrine deposits

Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes by water originating mainly from the melting of glacial ice. Many are bedded or laminated with varves.

## glacial till

Unsorted and unstratified glacial drift, generally unconsolidated, deposited directly by a glacier without subsequent reworking by water from the glacier, and consisting of a heterogeneous mixture of clay, sand, gravel, and boulders varying widely in size and shape. (cf. ablation till, basal till)

## gulch

A small stream valley, narrow and steep-sided in cross section, and larger than a gully. (Regional term - western U.S.A.; general syn. ravine; cf. draw)

geomorphic surface

A geomorphic surface represents an episode of landscape development and consists of one or more landforms (Bastin and Parsons). A specific part of the land surface that is defined in terms of morphology (relief, slope, aspect, etc.), origin (tectonic, constructional, etc.), age (absolute, relative), and stability of component landforms. (cf. buried, exhumed, relict)

glacial drift

All rock material transported and deposited by glacial ice and meltwater; includes glacial till, glacialfluvial (outwash), and glaciolacustrine deposits from alpine, glacial, or continental glaciers.

glacial outwash

Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by water that originated mainly from the melting of glacial ice. Outwash deposits may occur in the form of valley fills (valley trains and/or outwash terraces) or as widespread outwash plains. (cf. glacial drift, glaciolacustrine deposits)

glaciolacustrine deposits

Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and may occur in the form of outwash plains, valley trains, and deltas, fans, etc., and lake basins. (cf. glacial drift and glacial outwash)

glaciolacustrine deposits

Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes by water originating mainly from the melting of glacial ice. They are bedded or laminated with varves.

glacial till

Unsorted and unstratified glacial drift, generally unconsolidated, deposited directly by a glacier without subsequent reworking by water from the glacier, and consisting of a heterogeneous mixture of clay, sand, gravel, and boulders varying widely in size and shape. (cf. outwash fill, basal till)

gully

A small stream valley, narrow and incised in cross section, and larger than a gully. (Regional form - western U.S.A.; general form - ravine; cf. draw)



## gully

A very small valley with steep sides cut by running water and through which water ordinarily runs only after a rain or ice or snow melt. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to wheeled vehicles and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage. (cf. gulch, arroyo, wash, draw)

## hill

A natural elevation of the land surface, rising as much as 1,000 ft (300 m) above surrounding lowlands, usually of restricted summit area (relative to a tableland) and having a well-defined outline; hill slopes generally exceed 15%. The distinction between a hill and a mountain is often dependent on local usage. (cf. foothills)

## hillslope

The steeper part of a hill between its summit and the drainage line, valley flat or depression floor at the base of the hill. In descending order geomorphic components of a simple hillslope may include shoulder, backslope, footslope and toeslope. However, all of these components are not necessarily present in any given hillslope continuum. In addition, complex hillslopes may include two or more backslope to toeslope sequences.

## hogback

A sharp-crested, symmetric (homoclinal) ridge formed by highly tilted resistant rock layers; produced by differential erosion of interlayered resistant and weak rocks with dips greater than about  $25^{\circ}$  (45%). (cf. cuesta)

## Holocene

The second epoch of the Quaternary Period of geologic time, extending from the end of the Pleistocene Epoch (about 10 to 12 thousand years ago) to the present; also the corresponding (time-stratigraphic) "series" of earth materials. (syn. post-glacial, Recent)

## homoclinal (structural geomorph.)

Pertaining to strata that dip in one direction with a uniform angle. (cf. cuesta, hogback)

## igneous rock

Rock formed by solidification from a molten or partially molten state; major varieties include plutonic and volcanic rocks. (cf. intrusive, extrusive; Examples: andesite, basalt, granite)

gully

A very small valley with steep sides cut by running water and through which water ordinarily runs only after a rain or ice or snow melt. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to wheeled vehicles and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage. (cf. gulch, arroyo, wash, draw)

hill

A natural elevation of the land surface, rising as much as 1,000 ft (300 m) above surrounding lowlands, usually of restricted summit area (relative to a plateau) and having a well-defined outline; hill slopes generally exceed 15%. The distinction between a hill and a mountain is often dependent on local usage. (cf. foothills)

hillslope

The steeper part of a hill between its summit and the drainage line, valley flat or depression floor at the base of the hill. In descending order geomorphic components of a simple hillslope may include shoulder, backslope, footslope and toeslope. However, all of these components are not necessarily present in any given hillslope continuum. In addition, complex hillslopes may include two or more backslope to toeslope sequences.

horst

A sharp-crested, symmetric (basalinal) ridge formed by highly tilted, resistant and weak rocks with dips greater than about 25° (45%). (cf. cuesta)

holocene

The second epoch of the Quaternary Period of geologic time, extending from the end of the Pleistocene Epoch (about 10 to 12 thousand years ago) to the present; also the corresponding (time-stratigraphic) "series" of earth materials. (Syn. post-glacial, Recent)

horizontal (structural geograph.)

Referring to strata that dip in one direction with a uniform angle. (cf. cuesta, hogback)

igneous rock

Rock formed by solidification from a molten or partially molten state; major varieties include plutonic and volcanic rocks. (cf. intrusive, extrusive; basaltic, andesitic, basalt, granite)



## intermittent stream

A stream, or reach of a stream, that flows for protracted periods only when it receives ground-water discharge or long-continued contributions from melting snow or other surface and shallow subsurface sources. (cf. ephemeral stream)

## intrusive

Denoting igneous rocks derived from molten matter (magmas) which invaded pre-existing rocks and cooled below the surface of the earth. (cf. extrusive)

## joint (geology)

A surface of actual or potential fracture or parting in a rock, without displacement; the surface is usually plane and often occurs with parallel joints to form part of a joint set.

## kame

A moundlike hill of ice-contact glacial drift, composed chiefly of stratified sand and gravel.

## kame terrace

A terrace-like ridge consisting of stratified sand and gravel (1) deposited by a meltwater stream flowing between a melting glacier and a higher valley wall or lateral moraine, and (2) left standing after the disappearance of the ice. It is commonly pitted with "kettles" and has an irregular ice-contact slope.

## karst

A type of topography that is characterized by closed depressions or sink holes, and is dependent upon underground solution and the diversion of surface waters to underground routes. It is formed over limestone, dolomite, gypsum and other soluble rocks as a result of differential solution of these materials and associated processes of subsurface drainage, cave formation, subsidence, and collapse.

## kettle

A steep-sided, bowl-shaped depression without surface drainage in glacial drift deposits and believed to have formed by the melting of a large, detached block of stagnant ice buried in the glacial drift.

## knickpoint

Any interruption or break in slope; a point of abrupt inflection in the longitudinal profile of a stream or of its valley.

intermittent stream

A stream, or reach of a stream, that flows for protracted periods only when it receives ground-water discharge or long-continued contributions from melting snow or other surface and shallow subsurface sources. (Cf. ephemeral stream)

intrusive

Denoting igneous rocks derived from molten matter (magma) which invaded pre-existing rocks and cooled below the surface of the earth. (Cf. extrusive)

joint (geology)

A surface of actual or potential fracture or parting in a rock, without displacement; the surface is usually plane and often occurs with parallel joints as two part of a joint set.

karst

A karstlike hill of ice-contact glacial drift, composed chiefly of stratified sand and gravel.

karst terrace

A terrace-like ridge consisting of stratified sand and gravel (1) deposited by a meltwater stream flowing between a retreating glacier and a higher valley wall or karstic escarpment, and (2) left standing after the disappearance of the ice. It is commonly pitted with "potholes" and has an irregular ice-contact slope.

karst

A type of topography that is characterized by closed depressions or sink holes, and is dependent upon underground solution and the diversion of surface waters to underground courses. It is formed over limestone, dolomite, gypsum and other soluble rocks as a result of differential solution of these materials and associated processes of subsurface drainage, cave formation, subsidence, and collapse.

karstic

A steep-sided, bowl-shaped depression without surface drainage in glacial drift deposits and believed to have formed by the melting of a large, detached block of stagnant ice buried in the glacial drift.

karstic

The indentation or break in slope; a point of abrupt inflection in the longitudinal profile of a stream or of its valley.



## knoll

A small, low, rounded hill rising above adjacent landforms. (syn. hillock, knob)

## lacustrine deposit

Clastic sediments and chemical precipitates originally deposited in lakes.

## lahar

A mudflow composed chiefly of volcaniclastic materials on the flank of a volcano. The debris carried in the flow includes pyroclastic material, blocks from primary lava flows, and epiclastic material.

## lamination (lamina)

A sedimentary layer less than 1 centimeter thick.

## landform

Any physical, recognizable form or feature of the earth's surface, having a characteristic shape, and produced by natural causes; it includes major forms such as a plain, plateau, or mountain, and minor forms such as a hill, valley, slope, esker, or dune. Taken together, the landforms make up the surface configuration of the earth. The "landform" concept involves both empirical description of a terrain (land-surface form) class and interpretation of genetic factors ("natural causes").

## landscape

(Gen.) All the natural features, such as fields, hills, forests, and water that distinguish one part of the earth's surface from another part; usually that portion of land which the eye can comprehend in a single view, including all of its natural characteristics. (Geol.) The distinct association of landforms, esp. as modified by geologic forces, that can be seen in a single view.

## landslide

A mass-wasting process, and the landform produced, involving moderately rapid to rapid (greater than one foot per year) downslope transport, by means of gravitational stresses, of a mass of rock and regolith that may or may not be water saturated.





## land-surface form

The description of a given terrain unit based on empirical analysis of the land surface rather than interpretation of genetic factors. Surface form may be expressed quantitatively in terms of vertical and planimetric slope-class distribution, local and absolute relief, and patterns of terrain features such as interfluvial crests, drainage lines, or escarpments.

## limestone

A sedimentary rock consisting chiefly (more than 50%) of calcium carbonate, primarily in the form of calcite. Limestones are usually formed by a combination of organic and inorganic processes and include chemical and clastic (soluble and insoluble) constituents; many are fossiliferous.

## lithification

The conversion of a newly deposited, unconsolidated sediment into a coherent and solid rock, involving processes such as cementation, compaction; desiccation, crystallization, recrystallization, and compression. It may occur concurrent with, or shortly or long after deposition.

## lithologic

Pertaining to the physical character of a rock.

## loess

Fine-grained wind-deposited material, dominantly of silt-size.

## marl

An earthy, unconsolidated deposit consisting chiefly of calcium carbonate mixed with clay in approximately equal proportions (35-65% of each); formed primarily under freshwater lacustrine conditions, but varieties associated with more saline environments also occur.

## mass wasting (mass movement)

Dislodgement and downslope transport of earth (regolith and rock) material as a unit under direct gravitational stress. The process includes slow displacements such as creep, and solifluction, and rapid movements such as landslides, rock slides and falls, earthflows, debris flows, and avalanches. Agents of fluid transport (water, ice, air) may play a subordinate role in the process.

## meander, meandering channel (flood-plain landforms)

A meander is one of a series of sinuous loops, with sine-wave form, in the course of a stream channel. The term "meandering" should be restricted to

The description of a given terrain will depend on empirical analysis of the land surface rather than interpretation of genetic factors. Surface form may be measured quantitatively in terms of vertical and planimetric slope, plan distribution, local and absolute relief, and patterns of various features such as interfluvial crests, drainage lines, or escarpments.

Diastrophism

A sedimentary rock consisting chiefly (more than 50%) of calcium carbonate, primarily in the form of calcite. Limestones are usually formed by a combination of organic and inorganic processes and include chemical and physical (soluble and insoluble) constituents; many are fossiliferous.

Lithification

The conversion of a body deposited, unconsolidated sediment into a coherent and solid rock, involving processes such as cementation, compaction, desiccation, crystallization, recrystallization, and compression. It may occur concurrently with or shortly after deposition.

Lithology

Referring to the physical character of a rock.

Grain

The grain of a mineral or rock, denoting its size.

Clay

An earthy, amorphous, and highly plastic substance consisting chiefly of calcium carbonate mixed with clay in approximately equal proportions (35-65% of each); formed primarily under freshwater conditions, but varieties associated with marine salinity environments also occur.

Mass wasting (mass movement)

Displacement and downward movement of earth (regolith) and rock material as a unit under direct gravitational stress. The process includes slow displacement with or without soil, and soil creep, and rapid movements such as landslides, rock slides and falls, earthflows, debris flows, and avalanches. Slides of fluid muds (water, ice, etc.) may give a secondary role in the process.

Meander, meandering channel (wind-blown sandbar)

A meander is one of a series of sinuous bays, with streamway form, in the course of a stream channel. The term "meandering" should be restricted to



Loops with channel length more than 1.5 to 2 times the length of the wave form. Meandering stream channels commonly have cross sections with low width to depth ratios, (fine-grained) cohesive bank materials, and low gradient. At a given bank-full discharge meandering streams have gentler slopes, and deeper, narrower and more stable channel cross-sections than braided streams. (cf. flood-plain landforms)

#### meander belt (flood-plain landforms)

The bottomland zone within which migration of a meandering channel occurs; the flood-plain area included between two imaginary lines drawn tangentially to the outer bends of active channel loops. Landform components of the meander-belt surface are produced by a combination of gradual (lateral and down-valley) migration of meander loops and evulsive channel shifts causing abrupt cut-offs of loop segments. Forms flanking the sinuous stream channel include: point bars made up of one or more low, arcuate bar ridges and intervening swales that form by accretion of bed and suspended load on the convex banks of loops; and scars of abandoned meanders and flanking point bars. Sandy to gravelly bed load materials form the bulk of point bar deposits, and individual ridge-swale pairs are termed meander scrolls. Oxbow lakes are flooded segments of abandoned meander loops within which fine-grained suspended-load material accumulates over coarser channel deposits. During flood stages when a stream overtops its banks and spreads out over adjacent flood-plain areas, flow velocities are reduced and coarser fractions of the sediment load are commonly deposited close to the channel. Natural levees are wedge-shaped deposits of coarsest suspended-load material that form long, low ridges on channel banks and slope gently away from the stream. Flood-plain splays are small alluvial fans formed where the flooding stream breaks through a levee (natural or artificial) and deposits the coarser part of its load on the adjacent flood plain (e.g., backswamp or valley-flat surfaces). Many meander belts do not exhibit prominent natural levee or splay forms. Flood plains of broad alluvial valleys may contain one or more abandoned meander belts in addition to the zone flanking the active stream channel.

#### meander scroll

(cf. meander belt)

#### mesa

A broad, nearly flat-topped and usually isolated upland mass characterized by summit widths that are greater than the heights of bounding erosional escarpments. A tableland produced by differential erosion of nearly horizontal, interbedded weak and resistant rocks, with the latter comprising caprock layers. As summit area decreases relative to height mesas are transitional to buttes. In the western states mesa is also commonly used to designate broad structural benches and alluvial terraces that occupy intermediate levels in stepped sequences of platforms bordering canyons and valleys. (cf. plateau, cuesta)



low with channel length more than 1.5 to 2 times the length of the wave form. Wandering stream channels commonly have cross sections with low width to depth ratios, (fine-grained) cohesive bank materials, and low gradient. At a given bank-full discharge wandering streams have gentler slopes, and deeper, narrower and more stable channel cross sections than braided streams. (cf. flood-plain landforms)

meander belt (flood-plain landforms)

The bottomland zone within which migration of a meandering channel occurs; the flood-plain area included between two imaginary lines drawn tangentially to the outer banks of active channel loops. Landform components of the meander belt include a combination of gradual (factors) and steep (factors) migration of meander loops and evulsive channel shifts causing abrupt cut-offs of loop segments. Loops flanking the sinuous stream channel (factors) which have set up by one or more low, arcuate bar ridges and (factors) which have set up by accretion of bed and suspended load on the convex bank of loops; and scars of abandoned meanders and flanking point bars. Scars to gravelly bed load materials form the bulk of point bar deposits, and (factors) ridges are formed meander scarps. Oxbow lakes are (factors) of abandoned meander loops within which fine-grained suspended-load material accumulates over lower channel deposits. During flood stages when a channel overtops its banks and spreads out over adjacent flood-plain areas, the particles are reduced and coarser fractions of the sediment load are commonly deposited close to the channel. Natural levees are wedge-shaped deposits of coarsest suspended-load material that form long, low ridges on channel banks and slope gently away from the stream. Flood-plain soils are well (factors) from formed where the flooding stream breaks through a levee (factors) and deposits the coarser part of its load on the adjacent flood plain (e.g., backwash or valley-flooding surfaces). Many meander belts do not exhibit prominent natural levees or spay forms. Flood plains of broad alluvial valleys may contain one or more abandoned meander belts in addition to the zone flanking the active stream channel.

meander scarps

(cf. meander belt)

1000

A broad, nearly flat-topped and usually isolated upland mass characterized by summit widths that are greater than the heights of bounding erosional escarpments. A tabular plateau is distinguished by nearly horizontal, interbedded weak and resistant rocks, with the latter constituting escarpment faces. As summit area decreases relative to height mass and transition to plateau. In the western states such is also commonly used to designate broad (factors) and alluvial terraces that occupy intermediate levels in (factors) of plateaus bordering canyons and valleys. (cf. plateau, mesa)



## metamorphic rock

Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement at depth in the earth's crust. Nearly all such rocks are crystalline. (Example: schist, gneiss, quartzite)

## metastable slope

A slope that is relatively stable at the present time, but may become active if the environmental balance is disturbed, for instance, by road construction or destruction of vegetation. A metastable slope is often related to base levels of former geomorphic episodes. The regolith is generally moderately deep, may contain stone lines, or relict evidence of slope alluvium. Slope gradients usually range from 15 to 45 percent. (cf. active slope)

## monocline

A unit of folded strata that flexes from the horizontal in one direction only, and is not part of an anticline or syncline. This structure is typically present in plateau areas where nearly flat strata locally assume steep dips to differential vertical movements without faulting.

## moraine (general)

An accumulation of drift, with an initial topographic expression of its own, built chiefly by the direct action of glacial ice. Examples are end, ground, lateral, recessional, and terminal moraines. (cf. glacial till)

## moraine (end)

A moraine produced at the front of an actively flowing glacier at any given time. (cf. terminal and recessional moraines)

## moraine (ground)

An extensive, fairly even and thin layer of till, having an undulating surface; a deposit of rock debris dragged along, in, on and beneath a glacier and emplaced by processes including basal lodgement and release from downwasting stagnant ice (by ablation).

## moraine (lateral)

A ridge-like moraine carried on and deposited at the side margin of a valley glacier. It is composed chiefly of rock fragments derived from valley walls by glacial abrasion and plucking, or mass-wasting.

metastable slope

Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement at depth in the earth's crust. Nearly all such rocks are crystalline. (Example: schist, gneiss, quartzite)

metastable slope

A slope that is relatively stable at the present time, but may become active if the environmental balance is disturbed, for instance, by road construction or destruction of vegetation. A metastable slope is often related to low levels of tectonic geomorphic equilibrium. The rock is generally moderately hard, and contains stone lines or other evidence of slope adjustment. Slope gradients usually range from 15 to 45 percent. (cf. active slope)

monocline

A kind of folded strata that flexes from the horizontal in one direction only, and is not part of an anticline or syncline. This structure is typically present in places where nearly flat strata locally assume steep dips to different vertical movements without faulting.

moraine (general)

An accumulation of drift, with an initial topographic expression of its own, built chiefly by the direct action of glacial ice. Examples are end moraine, lateral moraine, and terminal moraine. (cf. glacial drift)

moraine (end)

A moraine produced at the front of an actively flowing glacier at any given time. (cf. lateral and recessional moraines)

moraine (ground)

An extensive, fairly even and thin layer of till, having an undulating surface, a deposit of rock debris dragged along, in, on and beneath a glacier and deposited by processes including basal lodgment and release from compressing stagnant ice (by solution).

moraine (lateral)

A ridge-like moraine carried on and deposited at the side margin of a glacier. It is composed chiefly of rock fragments derived from valley walls by glacial abrasion and plucking, or rock casting.



moraine (recessional)

An end moraine, built during a temporary but significant halt in the final retreat of a glacier.

moraine (terminal)

An end moraine that marks the farthest advance of a glacier and usually has the form of a massive arcuate ridge, or complex of ridges, underlain by till and other drift types.

mountain

A natural elevation of the land surface, rising more than 1,000 ft (300 m) above surrounding lowlands, usually of restricted summit area (relative to a plateau), and generally having steep sides (>25% slope) and considerable bare-rock surface. A mountain can occur as a single, isolated mass, or in a group forming a chain or range. Mountains are primarily formed by deep seated earth movements and/or volcanic action and secondarily by differential erosion. (cf. hill)

mudstone

Sedimentary rock formed by induration of silt and clay in approximately equal proportions.

natural levee

(cf. meander belt)

outwash plain

An extensive lowland area forming the surface of a body of coarse textured, glaciofluvial material. An outwash plain is commonly smooth; where pitted, due to melt-out of incorporated ice masses, it is generally low in relief. (cf. glacial outwash, kettles)

oxbow

(cf. meander belt)

paleosol

A soil that formed on a landscape of the past (Ruhe) with distinctive morphological features resulting from a soil-forming environment that no longer exists at the site. The former pedogenic process was either altered because of external environmental change or interrupted by burial. A paleosol (or component horizon) may be classed as relict if it has persisted in a land-surface position without major alteration of morphology by processes of

(relational)

in an erosion, built during a temporary but significant halt in the (final retreat of a glacier.

(erosion)

An erosion that marks the farthest advance of a glacier and usually has the form of a massive arcuate ridge, or complex of ridges, underlain by (1) and other drift types.

(erosion)

A natural elevation of the land surface, rising more than 1,000 ft (300 m) above surrounding lowlands, usually of restricted summit area (relative to a plateau), and generally having steep sides (25% slope) and considerable relief. A mountain can occur as a single, isolated mass, or in a group forming a chain or range. Mountains are primarily formed by deep seated earth movements and/or volcanic action and secondarily by differential erosion. (cf. hill)

(erosion)

Sedimentary rock formed by induration of silt and clay in approximately equal proportions.

(erosion)

(cf. meander belt)

(erosion)

An extensive lowland area forming the surface of a body of coarse textured, glacial material. An outwash plain is commonly smooth; where glacial outwash, it is generally low in relief. (cf. glacial outwash, patina)

(erosion)

(cf. meander belt)

(erosion)

A well defined or a landscape of the past (often) with distinctive morphological features resulting from a soil-forming environment that no longer exists at the site. The former pedogenic process was either altered because of external environmental change or interrupted by burial. A palaeosol (or component horizon) may be classed as relict if it has persisted in a land-surface position without major alteration of morphology by processes of



the prevailing pedogenic environment. An exhumed paleosol is one that formerly was buried and has been re-exposed by erosion of the covering mantle. Most paleosols have been affected by some modification of diagnostic-horizon morphologies and profile truncation.

#### patterned ground

A term for the more or less symmetrical forms such as circles, polygons, nets, stripes, garlands, and steps that are characteristic of, but not confined to, mantles subjected to intense frost action as in periglacial environments. Stone polygons generally form on slopes of less than 8 percent, while garlands and stripes occur on slopes of 8-15 percent and more than 15 percent, respectively (Parsons, 1976).

#### peak

Sharp or rugged upward extension of a ridge chain, usually at the junction of two or more ridges; the prominent highest point of a summit area.

#### pediment

A gently sloping erosional surface developed at the foot of a receding hill or mountain slope. The surface may be essentially bare, exposing earth material that extends beneath adjacent uplands; or it may be thinly mantled with alluvium and colluvium, ultimately in transit from upland front to basin or valley lowland. (In hill-footslope terrain the mantle is designated "pediment" by Ruhé). The term has been used in several geomorphic contexts: Pediments may be classed with respect to (1) landscape position, for example intermontane-basin piedmont or valley-border footslope surfaces (respectively, apron and terrace pediments of Cooke and Warren), (2) type of material eroded, bedrock or regolith, or (3) combinations of the above.

#### periglacial

Pertaining to processes, conditions, areas, climates, and topographic features occurring at the immediate margins of former and existing glaciers and ice sheets, and influenced by cold temperature of the ice. The term was originally introduced to designate the climate and related geologic features peripheral to ice sheets of the Pleistocene. It has been loosely defined to include frost-action effects and loess deposits that may or may not be related to glaciers.

#### piedmont slope

The dominant gentle slope at the foot of a mountain; generally used in terms of intermontane-basin terrain in arid to subhumid regions. Main components include: (1) an erosional surface on bedrock adjacent to the receding mountain front (pediment); (2) a constructional surface comprising individual alluvial fans and interfan valleys, also near the mountain front; and (3) a distal complex of coalescent fans (bajada), and alluvial slopes without fan form. Piedmont slopes grade to either basin-floor depressions with alluvial and temporary lake plains or surfaces of through drainage. (cf. bolson)



The prevailing geomorphic environment. An exposed plateau is one that formerly was covered and has been re-exposed by erosion of the covering mantle. Most plateaus have been affected by some modification of diastrophic-horizon unroofing and partial truncation.

patterned ground

A term for the name or less symmetrical forms such as circles, polygons, etc., stripes, bands, and steps that are characteristic of, but not confined to, mantle subjected to intense frost action as in periglacial environment. These polygons generally form on slopes of less than 8 percent, while stripes and stripes occur on slopes of 8-15 percent and more than 15 percent, respectively (Parsons, 1916).

peak

Sharp or rugged upward extension of a ridge chain, usually at the junction of one or more ridges; the prominent highest point of a summit area.

pediment

A gently sloping erosional surface developed at the foot of a receding cliff or escarpment. The surface may be essentially bare, exposing earth material that erodes beneath adjacent uplands; or it may be thinly mantled with alluvium and colluvium, ultimately in transit from upland front to basin or valley forward. The hill-footage terrain the entire is designated "pediment" by Davis. The term has been used in several geomorphic contexts. Pediments may be classed with respect to (1) landscape position, for example, intermontane-basin pediment or valley-border footslope surfaces (respectively, lower and terrace pediments of Cooke and Warren), (2) type of material eroded, and (3) combinations of the above.

periglacial

Pertaining to processes, conditions, areas, climates, and topographic features occurring at the immediate margins of former and existing glaciers and ice sheets, and influenced by cold temperatures of the ice. The term was originally introduced to designate the climate and related geologic features pertinent to the shores of the Pleistocene. It has been loosely defined to include frost-action effects and loess deposits that may or may not be related to glaciers.

pyramidal shape

The distinct gentle slope at the foot of a mountain; generally used in sense of intermontane-basin terrain in arid to subarid regions. Main components include: (1) an erosional surface on bedrock adjacent to the receding mountain front (pediment); (2) a confluential surface (alluvial fan) adjacent to the mountain front; and (3) a piedmont slope and alluvial valley, also near the mountain front, with an alluvial fan of coarsent fans (talus), and alluvial slopes without fan form. Mountain slopes grade to either basin-floor depressions with alluvial fan facies or plains or surfaces of through drainage. (C. Johnson)



## plain

An extensive lowland area that ranges from level to gently sloping or undulating. A plain has few or no prominent hills or valleys, and occurs at low elevation with reference to surrounding areas (local relief generally less than 100 m. (cf. plateau).

## plateau

An extensive upland mass with relatively flat summit area that is considerably elevated (more than 100 m) above adjacent lowlands, and is separated from them on one or more sides by escarpments. A comparatively large part of a plateau surface is near summit level. (cf. mesa, plain)

## playa

The usually dry and nearly level lake plain that occupies the lowest parts of closed depressions, such as those occurring on intermontane basin floors. Temporary flooding occurs primarily in response to precipitation-runoff events. Playa deposits are fine grained and may or may not be characterized high water table and saline conditions.

## Pleistocene

The first epoch of the Quaternary Period of geologic time, following the Tertiary Pliocene Epoch and preceding the Holocene (approx. from 2 million to 10 thousand years ago); also the corresponding (time-stratigraphic) "series" of earth materials. Glacial-interglacial stage/age subdivisions in North America include, in order of increasing age, Wisconsinan-Sangamonian, Illinoian-Yarmouthian, Kansan-Aftonian, and Nebraskan. (syn. Glacial epoch, Ice Age)

## Pliocene

The last epoch of the Tertiary Period of geologic time, following the Miocene Epoch and preceding the (Quaternary) Pleistocene Epoch (approx. 7 to 2 million years ago); also, the corresponding (time-stratigraphic) "series" of earth materials.

## plutonic

Pertaining primarily to igneous rocks formed deep in the earth's crust, but also including associated metamorphic rocks.

## pluvial lake

A lake formed in a period of exceptionally heavy rainfall; a lake formed in the Pleistocene epoch during a time of glacial advance, and now either extinct or existing as a remnant. (Example: Lake Bonneville, cf. periglacial)

plateau

An extensive plateau area that ranges from level to gently sloping or undulating. A plain has few or no prominent hills or valleys, and occurs at low elevation with reference to surrounding areas (local relief generally less than 100 m. (ft. plateau)).

plateau

An extensive upland area with relatively flat summit area that is consistently elevated (more than 100 m) above adjacent lowlands, and is separated from them on one or more sides by escarpments. A comparatively large part of a plateau surface is near summit level. (cf. mesa, plain)

plateau

The usually dry and nearly level lake plain that occupies the lowest parts of closed depressions, such as those occurring on intermontane basin floors. Temporary flooding occurs primarily in response to precipitation-runoff events. Playa deposits are fine grained and may or may not be characterized by high water table and saline conditions.

pluvial

The first epoch of the Quaternary. Period of geologic time, following the Tertiary Pleistocene Epoch and preceding the Holocene (approx. from 2 million to 10 thousand years ago); also the corresponding (time-stratigraphic) "series" of earth materials. Glacial-interglacial stage subdivisions in North America include, in order of increasing age, Wisconsinan-Sangamonian, Illinoian-Yarmouthian, Kansan-Atlatlan, and Nebraskan. (syn. Glacial epoch, Ice Age)

pluvial

The last epoch of the Tertiary period of geologic time, following the Miocene Epoch and preceding the (Quaternary) Pleistocene Epoch (approx. 7 to 2 million years ago); also, the corresponding (time-stratigraphic) "series" of earth materials.

pluvial

Referring primarily to igneous rocks formed deep in the earth's crust, but also including associated metamorphic rocks.

pluvial

A lake formed in a period of exceptionally heavy rainfall; a lake formed in the Pleistocene epoch during a time of glacial advance, and now either extinct or existing as a remnant. (Example: Lake Bonneville, cf. periglacial)



## pyroclastic

Pertaining to fragmental materials produced by usually explosive, aerial ejection of clastic particles from a volcanic vent. Such materials may accumulate on land or under water. (cf. epiclastic, volcaniclastic)

## Quaternary

The second period of the Cenozoic Era of geologic time, extending from the end of the Tertiary Period (about 2 million years ago) to the present and comprising two epochs, the Pleistocene (Ice Age) and the Holocene (Recent); also, the corresponding (time-stratigraphic) "system" of earth materials.

## ravine

A small stream valley; narrow, steep-sided, and commonly V-shaped in cross section; and larger than a gully. (general syn. gulch; cf. draw)

## regolith

All unconsolidated earth materials above the solid bedrock. It includes material weathered in place from all kinds of bedrock, and alluvial, glacial, eolian, lacustrine and pyroclastic deposits. Soil scientists regard soil as only that part of the regolith that is modified by organisms and other soil-forming forces. Most engineers describe the whole regolith, even to a great depth, as "soil." (cf. residuum)

## relict

Pertaining to surface landscape features (e.g., landforms, geomorphic surfaces, paleosols) that have never been buried and are products of past environments no longer operative in a given area. (cf. exhumed)

## relief

The elevations or inequalities of a land surface, considered collectively.

## residuum (residual soil material)

Unconsolidated, weathered, or partly weathered mineral material that only accumulates by disintegration of bedrock in place. (cf. saprolite, regolith)

## ridge

A long, narrow elevation of the land surface, usually sharp crested with steep sides and forming an extended upland between valleys. The term is used in areas of both hill and mountain relief (less and greater than 300 m).

Quaternary

Containing fragments of materials produced by usually explosive, vertical  
eruption of volcanic particles from a volcanic vent. Such materials may  
accumulate on land or under water. (cf. epiclastic, volcanoclastic)

Quaternary

The second period of the Cenozoic Era of geologic time, extending from  
the end of the Tertiary Period (about 2 million years ago) to the present and  
including the epochs, the Pleistocene (Ice Age) and the Holocene (Recent);  
also, the corresponding lithostratigraphic "system" of earth materials.

Valley

A small stream valley; narrow, steep-sided, and commonly V-shaped in  
cross section; and larger than a gully. (general syn. gully; cf. draw)

Regolith

All unconsolidated earth materials above the solid bedrock. It includes  
material weathered in place from all kinds of bedrock, and alluvial, glacial,  
colluvial, lacustrine and pyroclastic deposits. Soil scientists regard soil as  
only that part of the regolith that is modified by organisms and other  
soil-forming factors. Most engineers describe the whole regolith, even to a  
great depth, as "soil". (cf. residuum)

Relict

Remaining in surface landscape features (e.g., landforms, geomorphic  
features, etc.) that have never been buried and are products of past  
environments no longer operative in a given area. (cf. exhumed)

Relict

The elevation or topographic of a land surface, considered collec-  
tively.

Residual soil material

Inconsolidated, weathered, or partly weathered mineral material that may  
accumulate by disintegration of bedrock in place. (cf. saprolite, regolith)

Ridge

A long, narrow elevation of the land surface, usually sharp crested with  
steep sides and forming an extended ridge between valleys. The term is used  
in areas of both hills and mountains (less and greater than 300 m).



saddle

A low point on a ridge or crestline, generally a divide (pass, col) between the heads of streams flowing in opposite directions.

sandstone

Sedimentary rock containing dominantly sand-size clastic particles.

saprolite

Soft, clay-rich, thoroughly decomposed rock formed in place by chemical weathering of igneous and metamorphic rock. In soil science, the term saprolite is applied to any unconsolidated residual material underlying the soil and grading to hard bedrock below. (cf. residuum)

scoria

Vesicular, cindery, crust on the surface of andesitic or basaltic lava, the vesicular nature of which is due to the escape of volcanic gases before solidification; it is usually heavier, darker, and more crystalline than pumice. (syn. cinder)

scree

A heap of rock waste at the base of a cliff or a sheet of coarse debris mantling a slope. Scree is not a synonym of talus, as scree also includes loose material on slopes without cliffs.

sediment

Solid clastic material, both mineral and organic, that is in suspension, is being transported, or has been moved from its site of origin by water, wind, ice or mass-wasting and has come to rest on the earth's surface either above or below sea level. Sedimentary deposits in a broad sense also include materials precipitated from solution or emplaced by explosive volcanism, as well as organic remains (e.g., peat) that have not been subject to appreciable transport.

sedimentary rock

A consolidated deposit of clastic particles, chemical precipitates and organic remains accumulated at or near the surface of the earth under "normal" low temperature and pressure conditions. Sedimentary rocks include consolidated equivalents of alluvium, colluvium, glacial drift, and eolian, lacustrine and marine deposits (e.g., sandstone, siltstone, mudstone, claystone, and shale, conglomerate and limestone, dolomite, coal, etc.; cf. sediment).

bedrock

A low point on a ridge or crestline, generally a divide (pass, col) between the mass of strata flowing in opposite directions.

bedrock

Sedimentary rock containing distinctly sand-size clastic particles.

bedrock

Soil, clay-rich, thoroughly decomposed rock formed in place by chemical weathering of igneous and metamorphic rock. In soil science, the term saprolite is applied to any unconsolidated residual material underlying the soil and grading to hard bedrock below. (cf. residuum)

bedrock

Volcanic, stony, crust on the surface of andesitic or basaltic lava, the vesicular nature of which is due to the escape of volcanic gases before solidification; it is usually heavier, darker, and more crystalline than pumice. (Syn. scoria)

bedrock

A mass of rock waste at the base of a cliff or a sheet of coarse debris resulting from a slope. Scree is not a synonym of talus, as scree also includes loose material on slopes without cliffs.

bedrock

Solid clastic material, both mineral and organic, that is in suspension, is being transported, or has been moved from its site of origin by water, wind, ice or mass wasting and has come to rest on the earth's surface either above or below sea level. Sedimentary deposits in a broad sense also include materials precipitated from solution or emplaced by explosive volcanism, as well as organic remains (e.g., peat) that have not been subject to appreciable leaching.

bedrock

A consolidated deposit of clastic particles, chemical precipitates and organic remains accumulated at or near the surface of the earth under "normal" low temperature and pressure conditions. Sedimentary rocks include consolidated equivalents of glacial drift, alluvium, colluvium, glacial drift, and colluvium. lacustrine and marine deposits (e.g., sandstone, siltstone, mudstone, claystone, and shale, conglomerate and limestone, dolomite, coal, etc.; cf. sediment).



shale

Sedimentary rock formed by induration of a clay or silty clay deposit and having the tendency to split into thin layers (i.e., fissility)

shoulder (hillslope)

The geomorphic component that forms the uppermost inclined surface at the top of a hillslope. It comprises the transition zone from backslope to summit of an upland. The surface is dominantly convex in profile and erosional in origin.

sinkhole

A closed depression formed either by solution of the surficial bedrock (e.g., limestone, gypsum, salt) or by collapse of underlying caves. Complexes of sinkholes in carbonate-rock terranes are the main components of karst topography. (syn. doline)

slope alluvium

Sediment gradually transported on mountain or hill slopes primarily by alluvial processes and characterized by particle sorting. In a profile sequence, sediments may be distinguished by differences in size and/or specific gravity of coarse fragments and may be separated by stone lines. Sorting of rounded or subrounded pebbles or cobbles, and burned peds contrast with unsorted colluvial deposits.

slump

The downward slipping of a mass of rock or unconsolidated material of any size, moving as a unit or as several subsidiary units, usually with backward rotation on a more or less horizontal axis parallel to the cliff or slope from which it descends.

solifluction

Slow viscous downslope flow of water saturated regolith; especially the mass-wasting process occurring in areas of frozen ground, with alternate freezing and thawing of surficial materials.

spur

A secondary divide between minor drainage systems of an area, that generally has an inverted "V" shape, and occurs considerably below the elevation of the associated ridge.

Secondary rock formed by induration of a clay or silty clay deposit and having the tendency to split into thin layers (i.e., fissility).

slender (thin)

The geographic component that forms the uppermost inclined surface at the top of a hillside. It comprises the transition zone from backlogs to summit of an upland. The surface is dominantly convex in profile and erosional in origin.

strata

A closed formation formed either by solution of the surficial bedrock (e.g., limestone, gypsum, salt) or by collapse of underlying caves. Complexes of strata in carbonate rock formations are the main components of karst topography. (Syn. dolines)

stone

Bedrock gradually transformed on mountain or hill slopes primarily by attrition processes and characterized by particle sorting. In a profile, sedimentary beds may be distinguished by differences in size and/or specific gravity of coarse fragments and may be separated by stone lines. Sorting of rounded or subrounded pebbles or cobbles, and banded beds contrast with bedrock material.

stone

The downward slipping of a mass of rock or unconsolidated material of any size, moving as a unit or as several relatively units, usually with backward rotation on a wide or less horizontal axis parallel to the cliff or slope from which it descends.

stratification

The various downward flow of water saturated regolith; especially the downward flow of water saturated regolith in areas of frozen ground, with alternate freezing and thawing of surficial materials.

step

A secondary divide between river drainage systems of an area, that generally has an inverted "V" shape, and occurs considerably below the elevation of the associated ridge.



## steptoe

An island-like area in a lava flow.

## stone line

A sheet-like concentration of coarse fragments in surficial sediments. In cross-section, the line may be marked only by scattered fragments or it may be a discrete layer of fragments. The fragments are more often pebbles or cobbles than stones. A stone line generally overlies material that was subjected to weathering, soil formation, and erosion before deposition of the overlying material. Many stone lines seem to be buried erosion pavements, originally "formed by running water on the land surface and concurrently covered by surficial sediment" (Ruhe).

## strath terrace

(cf. stream terrace)

## stratified

Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

## stratigraphy

The branch of geology that deals with the definition and interpretation of stratified earth materials; the conditions of their formation; their character, arrangement, sequence, age, and distribution; and especially their correlation by the use of fossils and other means. The term is applied both to the sum of the characteristics listed and a study of these characteristics.

## stream order

In a drainage basin network, the smallest unbranched tributaries are designated order 1; the confluence of two first-order streams produces a stream segment of order 2; the junction of two second-order streams produces a stream segment of order 3; etc. The order of the drainage basin is determined by the highest integer.

## stream terrace

One of a series of platforms in a stream valley, flanking and more or less parallel to the stream channel, originally formed near the level of the stream, and representing the dissected remnants of an abandoned flood plain, stream bed, or valley floor produced during a former stage of erosion or deposition. Erosional surfaces cut on bedrock and thinly mantled with stream deposits (alluvium) are designated "strath terraces." Remnants of constructional valley floors are termed "alluvial terraces." (cf. terrace)

An island-like area in a lava flow

stone line

A sheet-like concentration of coarse fragments in surficial sediments. In cross-section, the line may be marked only by scattered fragments or it may be a discrete layer of fragments. The fragments are more often pebbles or cobbles than stones. A stone line generally overlies material that was subjected to weathering, soil formation, and erosion before deposition of the overlying material. Many stone lines seem to be buried erosion pavements, originally "formed by running water on the land surface and concurrently covered by surficial sediment" (Rube).

stone terrace

(cf. stream terrace)

stratified

Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

stratigraphy

The branch of geology that deals with the definition and interpretation of stratified earth materials; the conditions of their formation; their character, arrangement, sequence, age, and distribution; and especially their correlation by the use of fossils and other means. The term is applied both to the sum of the characteristics listed and a study of these characteristics.

stream order

In a drainage basin network, the smallest unbranched tributaries are designated order 1; the confluence of two first-order streams produces a stream segment of order 2; the junction of two second-order streams produces a stream segment of order 3; etc. The order of the drainage basin is determined by the highest integer.

stream terrace

One of a series of platforms in a stream valley, flanking and more or less parallel to the stream channel, originally formed near the level of the stream, and representing the dissected remnants of an abandoned flood plain, stream bed, or valley floor produced during a former stage of erosion or deposition. Erosional surfaces cut on bedrock and thinly mantled with stream deposits (alluvium) are designated "stone terraces." Remnants of constructional valley floors are termed "fluvial terraces" (cf. terrace).



## structural bench (or bench)

A platform-type, nearly level to gently inclined erosional surface developed on resistant strata in areas where valleys are cut in alternating strong and weak layers with an essentially horizontal attitude. Structural benches, in contrast to stream terraces, have no geomorphic implication of former, partial erosion cycles and base-level controls, nor do they represent a stage of flood-plain development following an episode of valley trenching.

## summit

A general term for the top, or highest level of an upland feature such as a hill, mountain, or tableland. It usually refers to a high interfluvial area of lower slope that is flanked by steeper sideslopes (e.g., hillslopes, mountain fronts, or tableland escarpments). Summit areas may or may not include distinct crest lines or high points that rise above their general level.

## swell-and-shale topography

Topography of ground moraine having low relief, gentle slopes, and well rounded hills interspersed with shallow depressions.

## syncline

A unit of folded strata that is concave upward. In a simple syncline, beds forming the opposing limbs of the fold dip toward its axial plane. (cf. anticline, monocline)

## tableland

A general term for a broad upland mass with nearly level or undulating summit area of large extent and steep sideslopes descending to surrounding lowlands. Varieties include plateaus, and mesas.

## talus

Rock fragments of any size or shape (usually coarse and angular) derived from and lying at the base of a cliff or very steep, rock slope. The accumulated mass of such loose broken rock formed chiefly by falling, rolling, or sliding. (cf. colluvium, mass wasting, scree)

## tephra

A collective term for all clastic volcanic materials which are ejected from a vent during an eruption and transported through the air, including volcanic ash, cinders, lapilli, scoria, pumice, bombs, and blocks. (syn. volcanic ejecta)

structural bench (or bench)

A platform-type, nearly level to gently inclined erosional surface developed on resistant strata in areas where valleys are cut in alternating strong and weak layers with an essentially horizontal attitude. Structural benches, in contrast to stream terraces, have no geomorphic implication of former, partial erosion cycles and base-level controls, nor do they represent a stage of flood-plain development following an episode of valley trenching.

summit

A general term for the top, or highest level of an upward feature such as a hill, mountain, or plateau. It usually refers to a high interfluvial area of lower slope that is flanked by steeper slopes (e.g., hillslopes, mountain fronts, or continental escarpments). Summit areas may or may not include distinct crest lines or high points that rise above their general level.

well-and-shade topography

Topography of ground surface having low relief, gentle slopes, and well-rounded hills interspersed with shallow depressions.

syncline

A unit of folded strata that is concave upward. In a simple syncline, the axial plane is concave upward. In a complex syncline, the axial plane is concave upward.

tableland

A general term for a broad upland with nearly level or undulating surface. Various include plateaus, and mesas.

talus

Rock fragments of any size or shape (usually coarse and angular) derived from weathering of a cliff or very steep, rock slope. The accumulation of such loose broken rock formed chiefly by falling, rolling, or sliding. (cf. colluvium, mass wasting, scree)

tealite

A collective term for all classic volcanic materials which are ejected from a vent during an eruption and transported through the air, including volcanic ash, cinders, lapilli, scoria, pumice, bombs, and blocks. (syn. volcanic ejecta)



## terrace (geomorphic)

A step-like surface, bordering a valley floor or shoreline, that represents the former position of an alluvial plain, or lake or sea shore. The term is usually applied to both the relatively flat summit surface (platform, tread), cut or built by stream or wave action, and the steeper descending slope (scarp, riser), graded to a lower base level of erosion. (cf. stream terrace)

## terraces

Small, irregular step-like forms on steep hillslopes, especially in pasture, formed by creep of surficial materials that may or may not be induced by trampling of livestock such as sheep or cattle. (syn. catsteps, sheep or cattle tracks, soil ripples)

## Tertiary

The first period of the Cenozoic Era of geologic time, following the Mesozoic Era preceding the Quaternary (approx. from 65 to 2 million years ago); also the corresponding time-stratigraphic subdivision (system) of earth materials. Epoch/series subdivisions comprise, in order of increasing age, Pliocene, Miocene, Oligocene, Eocene, and Paleocene.

## till plain

An extensive flat to undulating area underlain by glacial till. (cf. glacial till, moraine-ground)

## toeslope

The geomorphic component that forms the outermost, gently-inclined surface at the base of a hillslope. Toeslopes in profile are commonly gentle and linear; and in terms of gradational processes, they are constructional surfaces forming the distal part of a hillslope continuum that grades to valley or closed-depression floors. (cf. footslope, valley floor)

## topography

The relative positions and elevations of the natural or manmade features of an area that describe the configuration of its surface.

## upland (geomorphology)

Land at a higher elevation, in general, than the alluvial plain or low stream terrace; land above the footslope zone of the hillslope continuum.

Surface (geomorphic)

A step-like surface, bordering a valley floor or shoreline, that represents the former position of an alluvial plain, or lake or sea shore. The term is usually applied to both the relatively flat summit surface (plateau) and the steeper descending slope (escarpment), graded to a lower base level of erosion. (cf. stream terraces)

Terraces

Small, irregular step-like forms on steep hillslopes, especially in gneiss, formed by creep of surficial materials that may or may not be induced by overloading of livestock such as sheep or cattle. (syn. catsteps, sheep or cattle tracks, soil ripples)

Terrace

The first period of the Cenozoic Era of geologic time, following the Pleistocene. It preceded the Quaternary (approx. from 2.5 million years ago), and the corresponding lithostratigraphic subdivision (system) of earth materials. Geochronologic subdivisions comprise, in order of increasing age, Pliocene, Miocene, Oligocene, Eocene, and Paleocene.

Till plain

An extensive flat to undulating area underlain by glacial till. (cf. glacial till, moraine ground)

Topography

The geomorphic component that forms the outermost, gently-inclined surface at the base of a hillslope. Topography in profile are commonly gentle and linear; and in terms of geomorphic processes, they are constructional surfaces forming the distal end of a hillslope continuum that grades to valley or closed-depression floors. (cf. footslope, valley floor)

Topography

The relative positions and elevations of the natural or manmade features of an area that describe the configuration of its surface.

Upland (geomorphology)

Land at a higher elevation, in general, than the alluvial plain or low stream terrace; land above the footslope zone of the hillslope continuum.



## valley

An elongate, relatively large, externally-drained depression of the earth's surface that is primarily developed by stream erosion. (cf. basin-intermontane)

## valley-border surfaces

A general grouping of valley-side geomorphic surfaces that occur in a stepped sequence graded to successively lower stream base levels produced by episodic valley entrenchment.

## valley fill

The unconsolidated sediment deposited by any agent (water, wind, ice, mass wasting) so as to fill or partly fill a valley.

## valley flat (flood-plain landform)

A general term for broad, nearly level flood-plain surfaces that are not subject to frequent inundation. (cf. backswamp, meander belt)

## valley floor

A general term for the nearly level to gently sloping, bottom surface of a valley. Component landforms include axial stream channels, the flood-plain, and in some areas, low terrace surfaces that may be subject to flooding from tributary streams. (cf. flood-plain landforms, meander, braided channel, valley side)

## valley side (valley wall)

The sloping to very steep surfaces between the valley floor and summits of adjacent uplands. Well-defined, steep valley sides may be termed "valley walls." NOTE: Scale, relief, and perspective may require use of closely related terms such as hillslope, mountain slope, and ridge side.

## valley side alluvium

A concave "slopewash" deposit at the base of a hillslope, mountain slope, terrace escarpment, etc. that may or may not include the alluvial toeslope of a pediment.

## valley train

A long narrow body of glacial outwash confined within a valley below a glacier; it may, or may not, emerge from the valley and join an outwash plain.

valley

An elongate, relatively large, externally drained depression of the earth's surface that is primarily developed by stream erosion. (cf. interfluve)

valley-border surface

A general grouping of valley-side geomorphic surfaces that occur in a stream sequence graded to successively lower stream base levels produced by episodic valley enlargement.

valley fill

The unconsolidated sediment deposited by any agent (water, wind, ice, mass wasting) so as to fill or partly fill a valley.

valley flat (flood-plain landform)

A general term for broad, nearly level flood-plain surfaces that are not subject to frequent inundation. (cf. backwash, meander belt)

valley floor

A general term for the nearly level to gently sloping bottom surface of a valley. Component landforms include actual stream channels, the flood-plain, and in some areas, low terrace surfaces that may be subject to flooding from tributary streams. (cf. flood-plain landform, meander, braided channel, valley side)

valley side (valley wall)

The sloping to very steep surface between the valley floor and summits of adjacent uplands. Well-defined, steep valley sides may be termed "valley walls". Scale, relief, and perspective may require use of closely related terms such as hillslope, mountain slope, and ridge side.

valley side alluvium

A concave "stepped" deposit at the base of a hillslope, mountain slope, terrace escarpment, etc. that may or may not include the alluvial toe slope of a pediment.

valley train

A long narrow body of glacial outwash confined within a valley below a glacier; it may, or may not, merge from the valley and join an outwash plain.



## varve

A sedimentary layer, lamina or sequence of laminae, deposited in a body of still water within 1 year; specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

## volcanic

Pertaining to (1) the deep-seated (igneous) processes by which magma and associated gases rise through the crust and are extruded onto the earth's surface and into the atmosphere, and (2) the structures, rocks, and landforms produced. (cf. extrusive)

## volcaniclastic

Pertaining to the entire spectrum of fragmental materials with a preponderance of clasts of volcanic origin. The term refers not only to pyroclastic materials but also to epiclastic deposits derived from volcanic source areas by normal processes of mass wasting and stream erosion. (Examples: welded tuff, volcanic breccia)

## wash (dry wash)

The broad, flat-floored channel of an ephemeral stream, commonly with very steep to vertical banks cut in alluvium. NOTE: When channel reaches intersect zones of ground-water discharge they are more properly classed as "intermittent stream" channels. (Regional term - west U.S.A.; syn. arroyo)

## weathering

All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents with essentially no transport of the altered material. These changes result in disintegration and decomposition of the material. (cf. regolith, residuum, saprolite)

## wind gap

A former water gap now abandoned by the stream that formed it, suggesting stream piracy or stream diversion.

A sedimentary layer, lamina or sequence of laminae, deposited in a body of still water within a year, specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

volcanic

Pertaining to (1) the deep-seated (igneous) processes by which magma and entrained gases rise through the crust and are extruded onto the earth's surface and into the atmosphere, and (2) the structures, rocks, and landforms produced. (cf. extrusive)

volcaniclastic

Pertaining to the entire spectrum of fragmental materials with a preponderance of clasts of volcanic origin. The term refers not only to pyroclastic materials but also to volcaniclastic deposits derived from volcanic source areas by normal processes of mass wasting and stream action. (Examples: welded tuff, volcanic breccia)

wash (dry wash)

The broad, flat-floored channel of an ephemeral stream, commonly with very steep to vertical banks cut in alluvium. WASH: When channel reaches intersect zones of ground-water discharge they are more properly classed as "intermittent stream" channels. (Regional term - west U.S.A.; syn. arroyo)

weathering

All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents with essentially no transportation of the altered material. These changes result in disintegration and decomposition of the material. (cf. regolith, residual, saprolite)

wind gap

A former water gap now abandoned by the stream that formed it, suggesting stream piracy or stream diversion.



## Bibliography

- \*American Geological Institute: 1975. AGI Data Sheets (49 pocket-sized sheets of concise geological information): AGI, 5205 Leesburg Pike, Falls Church, VA 22041
- Balster, C. A. and R. B. Parsons, 1968. Geomorphology and Soils, Willamette Valley, Oregon. Ore. Agri. Exp. Sta. Spec. Report 265.31p.
- \*Bates, R.L. and Jackson, J.A. (editors). 1980. Glossary of Geology: American Geological Institute, Falls Church, VA, 749p.
- \*Birkeland, P. W. 1974. Pedology, Weathering and Geomorphic Research: Oxford University Press, New York, 285p.
- \*Bloom, A. L. 1978. Geomorphology: Prentice-Hall, Inc., Englewood Cliffs, N.J., 510p.
- \*Compton, R. R. 1962. Manual of Field Geology: John Wiley & Sons, Inc., New York, 378p.
- Compton, R. R. 1977. Interpreting the Earth: Harcourt-Brace-Jovanovich, Inc., New York, 554p.
- Cooke, R. V. and Warren, A. 1973. Geomorphology in Deserts: Univ. California Press, Berkeley, 374p.
- Fairbridge, R. W. (editor). 1968. The Encyclopedia of Geomorphology: Reinhold Book Corp., New York, 1295p.
- Flint, R. F. 1971. Glacial and Quaternary Geology: John Wiley & Sons, New York, 892p.
- \*Hamblin, W. Kenneth. 1975. The Earth's Dynamic Systems; A textbook in physical geology, with Student Study Guide: Burgess Publishing Company, Minneapolis, 578p.
- \*Hamblin, W. K. and Howard, J. D. 1980. Exercises in Physical Geology (5th edition): Burgess Publishing Company, Minneapolis, 225p.
- Hunt, C. B. 1974. Natural Regions of the United States and Canada: W. H. Freeman and Company, 725p.
- Morisawa, Marie. 1976. Geomorphology Laboratory Manual; with report forms: John Wiley & Sons, Inc., New York, 253p.
- Pettijohn, F. J. 1975. Sedimentary Rocks: Harper and Row, Publishers, New York, 628p.
- Ritter, D.F. 1978. Process geomorphology: Wm. C. Brown, Dubuque, Iowa, 603p.
- \*Ruhe, R. V. 1975. Geomorphology; geomorphic processes and surficial geology: Houghton-Mifflin Co., Boston, 246p.

Bibliography

American Geological Institute. 1972. AGI Data Sheets (49 pocket-sized sheets of concise geological information): AGI, 5205 Leasing Pike, Falls Church, VA 22041.

Balser, C. A. and R. E. Parsons, 1968. Geomorphology and Soils, Williams Valley, Oregon. Agr. Exp. Sta. Spec. Report 265.31p.

Baker, R. L. and Jackson, J. A. (editors). 1980. Glossary of Geology: American Geological Institute, Falls Church, VA. 749p.

Birkland, R. W. 1974. Pedology, Weathering and Geomorphic Research. Oxford University Press, New York, 282p.

Brown, R. L. 1978. Geomorphology: Prentice-Hall, Inc., Englewood Cliffs, N.J., 510p.

Coulton, R. R. 1962. Manual of Field Geology: John Wiley & Sons, Inc., New York, 518p.

Coulton, R. R. 1977. Integrating the Earth: Harcourt-Brace-Jovanovich, Inc., New York, 284p.

Coors, R. V. and Turner, A. 1973. Geomorphology in Deserts: Univ. California Press, Berkeley, 314p.

Fairbridge, R. W. (editor). 1968. The Encyclopedia of Geomorphology: Reinhold Book Corp., New York, 1332p.

Fair, R. F. 1971. Global and Quaternary Geology: John Wiley & Sons, New York, 624p.

Graham, W. Kenneth. 1975. The Earth's Dynamic System: A textbook in physical geology, with student study guides: Burgess Publishing Company, Minneapolis, 270p.

Graham, W. K. and Howard, J. D. 1980. Exercises in Physical Geology (7th edition): Burgess Publishing Company, Minneapolis, 225p.

Hart, C. B. 1974. Natural Regions of the United States and Canada: W. H. Freeman and Company, 732p.

Hartman, Haris. 1974. Geomorphology Laboratory Manual, with report forms: John Wiley & Sons, Inc., New York, 222p.

Hollister, F. J. 1958. Sedimentary Rocks: Harper and Row, Publishers, New York, 628p.

Kilian, G. F. 1978. Process geomorphology: Wm. C. Brown, Dubuque, Iowa, 403p.

Kubik, A. V. 1977. Geomorphology, Geomorphic Processes and Surface Geology: Longman-Wiley Co., Boston, 246p.



- Schumm, S.A. 1977. The fluvial system: John Wiley & Sons, Inc., New York, 338p.
- Thornbury, W. D. 1965. Regional Geomorphology of the United States: John Wiley & Sons, Inc., New York, 609p.
- Thornbury, W. D. 1969. Principles of Geomorphology: John Wiley & Sons, New York, 594p.
- Trewartha, G. T., Robinson, A. H., Hammond, E. H., and Horn, 1977, Fundamentals of Physical Geography (3rd edition): New York, McGraw-Hill Book Company.
- U.S. Geological Survey. 1970. The National Atlas of the United States Washington, D.C. (especially see sheets 61-63: Classes of Land-Surface Form by E.H. Hammond).
- Wyllie, P.J., 1976, The way the Earth works: John Wiley & Sons, Inc., New York, 296p.

\*Denotes books that would be useful in field office libraries.

Schum, S.A. 1937. The Rhyolite system. John Wiley & Sons, Inc., New York, 1937.

Thompson, W.B. 1955. Regional Geomorphology of the United States. John Wiley & Sons, Inc., New York, 1955.

Thompson, W.B. 1959. Principles of Geomorphology. John Wiley & Sons, New York, 1959.

Tracy, E.T., Robinson, A.H., Hammond, E.H., and Horn, 1937. Fundamentals of Physical Geography (3rd edition). New York, McGraw-Hill Book Company.

U.S. Geological Survey. 1910. The National Atlas of the United States. Washington, D.C. (especially see sheets 61-63: Classes of Land-Surfaces Form by E.H. Hammond).

Wittke, P.J. 1936. The way the Earth works. John Wiley & Sons, Inc., New York, 1936.

\*General books that would be useful to field office libraries.